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FIFRA SCIENTIFIC ADVISORY PANEL (SAP)

OPEN MEETING

AUGUST 26 - 27, 2004

FUMIGANT BYSTANDER EXPOSURE MODEL REVIEW:
THE FUMIGANT EXPOSURE MODELING SYSTEM (FEMS) USING
METAM SODIUM AS A CASE STUDY

THURSDAY, AUGUST 26, 2004

VOLUME I OF II

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Reported by: Frances M. Freeman, Stenographer

1

C O N T E N T S

2

3 Proceedings.....Page 3

1 DR. HEERINGA: Good morning. My name is Steve
2 Heeringa. I'm the chair for today's session and tomorrow.

3 I would like to welcome everyone to our two-day
4 meeting of the FIFRA Scientific Advisory Panel on the
5 topic of the Fumigant Bystander Exposure Model Review: The
6 Fumigant Exposure Modeling System (FEMS) Using Metam
7 Sodium as a Case Study.

8 Before we begin the proceedings, I would like to
9 go around the table and have the members of our Scientific
10 Review Board and SAP introduce themselves, beginning with
11 on my left.

12 DR. PORTIER: I'm Ken Portier, associate
13 professor of statistics at the University of Florida.

14 DR. HANNA: Adel Hanna, associate professor,
15 University of North Carolina.

16 DR. SHOKES: Fred Shokes, professor at Virginia
17 Tech.

18 DR. SEIBER: Jim Seiber with the U.S. Department
19 of Agriculture and the Agricultural Research Service in
20 the Albany, California, location. Formerly with
21 University of California, Davis, and University of Nevada,

1 Reno.

2 DR. WANG: I'm Dong Wang, associate professor of
3 the University of Minnesota. My expertise is in
4 environmental physics specializing in fumigant fate and
5 transport.

6 DR. WINEGAR: Eric Winegar, principal of Applied
7 Measurement Science in Sacramento, California.

8 DR. OU: I'm Li-Tse Ou, scientist with the
9 University of Florida.

10 DR. MAJEWSKI: Michael Majewski, a research
11 chemist with the U.S. Geological Survey.

12 DR. BAKER: Dan Baker, Shell Global Solutions in
13 Houston.

14 DR. BARTLETT: Paul Bartlett, Queens College,
15 City University of New York.

16 DR. SPICER: Tom Spicer, professor and head of
17 chemical engineering at the University of Arkansas.

18 DR. YATES: Scott Yates, acting research leader
19 at USDA ARS in Riverside, California.

20 DR. HEERINGA: I'm Steve Heeringa, University
21 for Michigan, Institute for Social Research. I would like

1 to, before we begin with the presentations and other
2 overviews this morning, turn to our designated federal
3 official for this two-day meeting, Mr. Paul Lewis, for his
4 introductory comments.

5 MR. LEWIS: Thank you, Dr. Heeringa.

6 I want to thank Dr. Heeringa for agreeing to
7 serve as our chair for the next two days of our Scientific
8 Advisory Panel meeting and again thank the members of the
9 panel for agreeing to serve and for your upcoming
10 deliberation and preparation of the meeting over the next
11 two days.

12 I'm Paul Lewis. I will be serving as the
13 Designated Federal Official for the FIFRA Scientific
14 Advisory Panel.

15 As DFO for this meeting, I serve as liaison
16 between the agency and the panel. And in that capacity,
17 I'm responsible for ensuring provisions of the Federal
18 Advisory Committee Act are met.

19 The Federal Advisory Committee Act in 1972
20 established a system of governing the creation, operation
21 and termination of executive branch advisory committees,

1 and the FIFRA Scientific Advisory Panel is subject to all
2 of FACA's requirements.

3 These include open meetings, timely public
4 notice of the meetings, and document availability, which
5 all our documents are available in the Office of Pesticide
6 Programs' Public Docket Office.

7 In addition, the major substantive documents are
8 available on the EPA Scientific Advisory Panel web site.

9 As the Designated Federal Official for this
10 meeting, a critical responsibility is to work with
11 appropriate agency officials to ensure all appropriate
12 ethic regulations are satisfied.

13 In that capacity, panel members are briefed with
14 provisions of federal conflict of interest laws. And each
15 participant has filed a standard government financial
16 disclosure report.

17 I, along with our deputy ethics officer for the
18 Office of Prevention of Pesticides and Toxic Substances,
19 and in consultation with the Office of General Counsel,
20 have reviewed the report to ensure all ethics requirements
21 are met. And a sample copy of this form is available on

1 our Scientific Advisory Panel web site.

2 The panel are reviewing several challenging
3 scientific issues over the next two days. We have a full
4 agenda and meeting times are approximate. Thus, may not
5 keep to exact times as noted due to panel discussions and
6 public comments. We strive to ensure adequate time for
7 presentations by the agency, public commenters and panel
8 deliberations.

9 For presenters, panel members and public
10 commenters, please identify yourselves and speak into the
11 microphones provided to ensure we have appropriate taping
12 for the meeting for the next two days.

13 And copies of presentation materials and public
14 comments will be available in the Office of Pesticide
15 Programs' Docket within the next few days.

16 For members of the public requesting time to
17 make a public comment, please limit your remarks to five
18 minutes unless prior arrangements have been made.

19 For those who have not preregistered, please
20 notify either myself or members of the SAP staff at the
21 table to the left of me in that corner to register to make

1 a public comment.

2 As I mentioned previously, there is a public
3 docket for this meeting and all background materials,
4 questions posed to the panel by the agency and other
5 documents related to this SAP meeting are available in the
6 docket. And our SAP meeting agenda lists the contact
7 information for locating the EPA docket office.

8 At the conclusion of this meeting, the SAP will
9 prepare a report as response to questions posed by the
10 agency, background materials, presentations, and public
11 comments. And this report serves as meeting minutes.

12 We anticipate the minutes will be completed in
13 approximately six to eight weeks after the close of this
14 meeting.

15 I'm looking forward to a very challenging and
16 enlightening discussion over the next two days. I want
17 to thank Dr. Heeringa again and our members of the panel
18 for agreeing to serve for these very challenging issues.
19 Thank you.

20 DR. HEERINGA: Thank you very much, Paul.

21 At this point in time I'm pleased to be able to

1 introduce Mr. Jim Jones who is the director of the Office
2 of Pesticide Programs with the EPA for some opening
3 remarks. Jim?

4 MR. JONES: Thanks, Dr. Heeringa. I just note
5 that my colleague, Joe Merenda, just arrived. I don't
6 know, Joe, if you were going to make some remarks or if
7 you would like to settle in first.

8 MR. HEERINGA: Mr. Joseph Merenda. Good
9 morning, Joe.

10 MR. MERENDA: Good morning. How are you,
11 Steve?

12 As the Director of EPA's Office of Science
13 Coordination and Policy, my office is responsible for
14 organizing these events, the FIFRA Scientific Advisory
15 Panel meetings.

16 Usually, we are the organizers and not the
17 subject matter expert. And that's the case today. But it
18 is certainly my great pleasure as the office director to
19 welcome all the members of the panel as well as the
20 members of the public who are participating to what we
21 consider to be one of the most important aspects of EPA's

1 science review process.

2 And that's getting external independent peer
3 review of issues and products that the agency has
4 developed or is considering for use as in the case of this
5 meeting and the associated ones on the models for
6 bystander exposure to fumigants.

7 So I would not want to take any more time than
8 necessary to simply welcome you, express great
9 appreciation for your service of EPA and the public by
10 participating in this. And I wish you a very productive
11 meeting. Thank you.

12 DR. HEERINGA: Thank you, Joe. We are pleased
13 to see you this morning.

14 Mr. Jones.

15 MR. JONES: Thanks, Dr. Heeringa, and thank you
16 for your leadership on this panel and the many panels
17 before you have led for the agency.

18 I also want to extend my welcome to the rest of
19 the panelists here this morning for the work that you have
20 already done in preparing for this meeting the work that's
21 going to occur over the next two days and subsequently as

1 you write up your recommendations to the agency.

2 I want to apologize for possibly -- well, I
3 certainly know I will for a number of you, repeating some
4 of the remarks that I made Tuesday morning as we have the
5 unusual occurrence of panel back to back where a number of
6 you have served on a similar topic for the last two days.

7 But I do see that there are a few new faces
8 around the room. Once again, I apologize in advance for
9 those of you who have heard my remarks before. But I
10 think it is important for us all to be operating off of
11 the same page as it relates to the context as to why we're
12 here.

13 As Joe mentioned, one of the hallmarks of our
14 work at the agency is sound science. And sound science
15 is really very much a part of why we convene independent
16 peer reviews such as the Scientific Advisory Panel. And
17 that's very important to us at the Environmental
18 Protection Agency.

19 Another part that is important to us is that we
20 conduct our business in a transparent way. And that is
21 that we try to do our business in front of the public. So

1 it is not just behind closed doors, but everybody gets an
2 opportunity to see what is the agency thinking about and
3 what are peer reviewers telling the agency, which is why
4 we hold these meetings in public.

5 I think, Dr. Heeringa, the last Scientific
6 Advisory Panel that you and I participated in, the chrome
7 sensitization one, we actually had a number of Scientific
8 Advisory Panel panelists, ad hoc members, who were from
9 other parts of the world who made it a point to recognize
10 the unusual aspect and from their perspective coming from
11 other countries the degree to which in this country we are
12 willing to talk about our business in a very public and
13 transparent manner.

14 And I think we forget that sometimes. But
15 that's very important for us at EPA to do this in a way
16 that is transparent to the public.

17 A little bit of context as to why we're here.
18 Again, I recognize I went over some of these points on
19 Tuesday morning. The agency is, the Office of Pesticide
20 Programs in particular, is looking at in its old chemicals
21 program as well as in its new chemical program a number of

1 fumigants for regulatory review for our safety review.

2 We are doing human health and environmental
3 assessments. We are focusing largely here on the human
4 health assessments. There are a handful of old chemicals
5 we are looking at. And there is one new fumigant.

6 And the new fumigant was actually used as an
7 example yesterday and the day before in the PERFUM model.

8 Today, one of the models that you will be
9 helping us to get our arms around is using as an example
10 one of the old chemicals that is under review.

11 We are looking at them all at the same time so
12 that we don't make decisions that just simply trade off
13 one fumigant risk for another one, where the one that's
14 left standing at the end or the two or three left standing
15 at the end end up also having all the benefits. We
16 basically are just shifting risk from one to another. We
17 are going to look at them all at the same time.

18 We are not here to talk about hazard. We are
19 not here to talk about all aspects of exposure, which are
20 the two key components to our risk assessment. We're here
21 to talk about one particular aspect of this chemical's

1 exposure.

2 That's the exposure to what we refer to as
3 bystanders. People who are near or around a treated
4 field. We have gone to various SAPs in the past eight
5 years as we have struggled with innovative, more accurate
6 ways of characterizing exposure.

7 They have included some of the drinking water
8 exposure analyses and assessment techniques that we have
9 talked to scientific advisory panels to probabilistic
10 dietary exposures.

11 Here, what we are looking for some advice on is
12 an enhancement to what -- what we would typically have
13 done is a deterministic exposure assessment where you have
14 measured exposure at various distances from a specific
15 field and so you have some measured values.

16 Well, that gives you interesting and useful
17 information in understanding exposure, but it certainly
18 doesn't fully characterize the exposure to bystanders. It
19 represents that measurement on that day under those
20 conditions in that locale.

21 And to really do a good job of characterizing

1 exposure, we are exploring models that can help us better
2 understand the distribution of exposures at various
3 distances under various conditions so that we have a more
4 robust exposure assessment.

5 And the fumigants are a class of chemicals that
6 have an exposure scenario. That is somewhat unlike most
7 of the compounds that we look at.

8 So whenever we are confronted with a challenging
9 scientific issue where we think it warrants independent
10 peer review and broader public involvement, what we like
11 to do is bring it to an analogous group like this to get
12 some advice.

13 And so today is the second in a series of three
14 models that we are looking for you to give us some advice
15 on.

16 Today the FEMS model is the one, today and
17 tomorrow, is the one that we'll be having some discussion
18 and getting some advice from the panel.

19 We very much look forward to that discussion and
20 advice. And I can assure you that the outcome of this
21 meeting, the last one and the next one that we are going

1 to have are going to be very important in the agency's
2 ultimate choices about how to evaluate exposure for these
3 very important compounds.

4 So I would like in closing to thank you very
5 much for all your hard work and your participation here
6 over the next few days. Thank you.

7 DR. HEERINGA: Thank you very much, Mr. Jones.
8 Appreciate those opening remarks.

9 At this point in time we have some additional
10 opening remarks from Ms. Margaret Stasikowski who is the
11 director of the Health Effects Division of the Office of
12 Pesticide Programs.

13 Margaret, welcome.

14 MS. STASIKOWSKI: Good morning.

15 Health Effects Division develops human health
16 risk assessments for conventional pesticides. As such,
17 over the last seven years, we have been in front of you at
18 least four, sometimes, six, seven times a year, because we
19 are doing so much on the cutting edge of risk assessment.

20 And we address wide ranging issues from hazard
21 toxicity issues to probabilistic models for exposure

1 assessment.

2 We spend a lot of hard, long evenings discussing
3 probabilistic risk assessment approaches for dietary
4 exposure assessment. We are now looking at a very cutting
5 edge issue of exposure assessment. And that's bystander
6 risk as a result of fumigants application.

7 We have been discussing with you cumulative risk
8 assessment for organophosphates. Many, many different
9 issues. This is the second of the three models that we
10 are asking for you to review for us.

11 We are asking that you review each of these
12 models on its own merits. And this is a similar way that
13 you approach looking at Cares, Lifeline and Calendex.

14 Today, we are going to be reviewing the fumigant
15 emissions model system. Mr. David Sullivan, from Sullivan
16 Environmental Consulting, will be presenting that model.
17 Mr. Jeff Dawson, our most experienced risk exposure
18 assessor, will be making the presentation.

19 MR. DAWSON: Thanks, Margaret.

20 What I would like to do this morning is just
21 very quickly set the stage and give you a primer that will

1 give some context to this meeting. What I would like to
2 do is give a little bit of background information about
3 the case study that we are talking about, touch a little
4 bit about the purpose of why we're here again and some of
5 the goals that we are looking at trying to achieve today.

6 And then as a basis for comparison, talk about
7 our current exposure assessment approach in a little bit
8 more detail, and then give a very brief summary of the
9 FEMS model. And, of course, Mr. Sullivan is going to be
10 talking about that in more detail.

11 Then at the end, I'm just going to touch on the
12 theme about the charge questions, and we'll read the
13 individual charge questions later in the day. For many of
14 you, this presentation will be very familiar.

15 So the background information I'm going to be
16 talking about again are the different modeling approaches,
17 the source of the information that we are looking at for
18 the case study, the purpose of the model and the goals of
19 today's meeting.

20 So again, the different modeling approaches that
21 we are looking at are PERFUM, FEMS and the SOFEA model,

1 which we'll look at in September. Today, we are again
2 focusing on the FEMS or the Fumigant Emissions Modeling
3 System.

4 In FEMS, what we are doing today is a case
5 study based on data from the soil fumigant, metam-sodium.

6 There are a number of studies, but the specific example
7 we are looking at today is one that is based on the use of
8 chemigation as an application method. And the control
9 technology to reduce emissions that went with that
10 application is known as intermittent water sealing. That
11 is a specific case study.

12 This is a little bit different than the last
13 couple days where there were a series of scenarios looked
14 at. In this case, it is one particular scenario.

15 Again, our key purposes here are to evaluate
16 these tools from the perspective of being better able to
17 estimate the distributions of bystander exposure compared
18 to what we are doing in our deterministic assessment.

19 And that's also going to allow us to do a better
20 characterization of the uncertainties and variability
21 associated with those assessments, which is a key piece of

1 information for us to provide to risk managers.

2 And then this slide just basically describes the
3 essentials that we are asking you to really look at
4 through the next couple days. That's to evaluate the
5 model based on the scientific validity, how transparent is
6 it as far as the starting point to output, what are the
7 specific data requirements needed to operate the system,
8 how applicable might this methodology be on a regional or
9 national level, and also, how portable might this system
10 be for use with other chemicals.

11 Because as Mr. Jones had indicated, we are
12 looking at a variety of fumigants, and we are interested
13 in using this methodology for several chemicals,
14 potentially.

15 So the next couple slides really summarize our
16 current approach. Again, we are taking a deterministic
17 approach at this point, basically.

18 Essentially, it is based on the use of the
19 industrial source complex short term model, which is a
20 standard model developed by the Office of Air.

21 It is routinely used for air permitting and

1 regulatory decisionmaking by that program. It is a steady
2 state Gaussian plume approach, which I'm sure we'll hear
3 about later in Mr. Sullivan's presentation.

4 It can look at different types of emission
5 sources. It is probably most commonly used for point
6 sources such as smoke stacks from a power plant, for
7 example.

8 It also can be used for linear sources such as
9 emissions from roadways and area sources. And the example
10 will here is a treated farm field, which is what we are
11 really going to be talking about the next few days.

12 It is also worth noting that I'm here with my
13 colleagues from the California Department of Pesticide
14 Regulation, Ms. Terri Barry on my right and Mr. Randy
15 Segawa on my left.

16 So they will be available to answer specific
17 questions and comment from the DPR perspective. But they
18 have a lot of experience with fumigant chemicals in
19 general. And their approach is also based on this model.

20 What I would like to do in the next couple
21 slides is just very briefly talk about the kinds of

1 deterministic inputs that we are using at this point.

2 We are very similar to what they are doing in
3 California in their regulations. We are looking at field
4 sizes from 1 to 40 acres. We are using a field geometry.

5 We are treating a field as a square. Again, that's just
6 like California.

7 And we are looking at varied atmospheric
8 conditions from a fairly stable environment, low wind
9 speeds. Basically, as low as the model can go up to
10 around 10 miles an hour.

11 We are also considering a range of stabilities,
12 which is a measure of turbulence in the atmosphere.

13 It is worth noting here that for the regulations
14 that DPR has completed, for example, on methylbromide,
15 they used a set of conditions at 3.1 miles per hour and
16 what is known as class C stability. And we'll talk about
17 that more too, I'm sure, in the next couple days.

18 Also, for the metam-sodium case, there is a
19 variety of studies available that we are looking at. And
20 they looked at different types of application methods; for
21 example, sprinkler and drip irrigation and shank

1 injections.

2 And also, different types of technologies that
3 can be used to control emissions. And in this case, the
4 data we had available were standard and intermittent water
5 sealing and then a variety of tarping techniques.

6 Keep in mind, though, that the specific case
7 study we are looking at is chemigation with the
8 intermittent water sealing. We just selected that one as
9 the case study.

10 And these data, we looked at these data and
11 quantified the flux or emission rates from the treated
12 fields. And the emission rates -- I'm sorry, the flux
13 rates that we calculated range from 5 to 98 and the units
14 are micrograms per meter squared of the treated field
15 surface area per second.

16 Essentially, what we have done is we have
17 calculated flux rates for each combination of application
18 equipment and control technologies we have available.

19 And what we found from this analysis was that
20 the drip irrigation was the lowest emitter and the use of
21 sprinkler irrigation led to the highest emissions.

1 And then there are other parameters that are
2 more generic with the use of ISC. This last part just
3 illustrates a couple of them that we use.

4 One is we use the rural conditions. This is a
5 flat terrain. We use an area source treated farm field
6 and we are using a release height of zero meters.

7 This just graphically illustrates the nature of
8 the outputs that we get from ISC in our current approach.

9 There on the left you will see the treated square field
10 here. And essentially, what we are doing is we are
11 calculating air concentrations at set downwind receptor
12 locations.

13 So essentially, what we get is, for example, in
14 this case we are calculating 24 hour average air
15 concentrations at these different locations downwind.

16 And the key issue to take away from this is that
17 we are using a wind direction that does not change over
18 the 24 hours. And we are assuming that it is going
19 downwind this way towards the receptors 100 percent of the
20 time over that 24 hour period.

21 This slide just shows what the results might

1 look like in tabular form. These numbers are actually
2 extracted directly from the SAP charge document that's
3 available up on the web site.

4 And essentially, what you have here, this is
5 just a measure of the emission rate, and this example is a
6 one square acre field, and this is the different sampling
7 locations downwind.

8 And these are air concentrations in micrograms
9 per cubic meter. As you go across the columns here, the
10 atmosphere becomes less and less stable.

11 So here you have a low wind speed and a very
12 stable environment. You see that the concentration there
13 is 573. It is relatively high compared to the
14 concentration in a less stable environment as you would
15 expect.

16 You can also see it is clear that as you go away
17 from the treated field, the concentrations go down, as you
18 would expect.

19 What we do with these is -- the ultimate goal is
20 to calculate a measure of risk, which is this MOE
21 calculation or margin of exposure. The way we calculate

1 that is divide it by some threshold which we call the HEC
2 or human equivalent concentration and divide the exposure
3 concentrations that we calculate with the model into that.

4 Now, just for contrast, I would just like to
5 very briefly summarize what FEMS can give you. We'll talk
6 a little bit about the components, you are going to hear
7 obviously a lot more about the details of this in a couple
8 of minutes, the basic set of inputs and the outputs you
9 can get from that system.

10 Again, FEMS is based on the use of the
11 industrial source complex ST3 model and also TOXST, which
12 is a processing program for outputs. I hope I said that
13 correctly.

14 Essentially, what it does is it provides a
15 probabilistic interface to support data entry into the
16 system. And some of the critical design elements are the
17 intermittent use of soil fumigants. So it looks at, for
18 example, one or two applications a year, I think, were
19 considered in a case study.

20 It can look at variability in emissions in
21 atmospheric conditions because it is using five years of

1 weather data, and it treats that probabilistically. It can
2 also evaluate uncertainty throughout the modeling process
3 and variability.

4 The particular case study from FEMS is looking
5 at a 20 acre field, rectangular shape, 5,000 simulations.

6 And David can talk more about this third bullet.

7 The emissions and wind speed direction are randomized,
8 and the atmospheric stability is not. It is one
9 application per year. The five years of data were from
10 Fresno, California, which is a high use area for
11 fumigants.

12 This slide, I'm sure he is going to present this
13 one as well, but this slide just shows how emission rates
14 can vary over time. These are different days. You see it
15 like, for example, on this red line it is the diurnal
16 pattern of emissions associated.

17 I apologize, I can't read that far away, but two
18 different sites. It is chemigation with different sealing
19 methods, I believe, on this slide.

20 And then this is hours after application and the
21 emission rates on this axis.

1 Then this is just the kind of output that you
2 can get from FEMS. And the way this is presented, it is
3 number of exceedances of a threshold around a treated
4 field, which is this red area in the middle.

5 And as the color goes up more and more red, you
6 get more exceedances, which is closer to the field, which
7 makes sense. I think this outer ring is a half of
8 exceedance per time frame. And these axes are distances
9 from the treated field.

10 Then, basically, I would just like to quickly
11 conclude with the theme of our discussion and the charge
12 questions is really threefold.

13 It is looking at the documentation of the
14 system, the overall system design and the inputs required
15 to operate the system, and then the types of results that
16 we can get from it. So how can they be presented and how
17 can they carry through the key characterization messages.

18 Thank you.

19 DR. HEERINGA: Thank you very much, Mr. Dawson.

20 I appreciate the introduction of your colleagues from the
21 California DPR. Welcome, Dr. Barry and Mr. Segawa.

1 At this point I would like to, before we move on
2 to the presentation on the FEMS model, I would like to
3 give the panel an opportunity to maybe address questions
4 to Mr. Dawson on the introductory material for this
5 session.

6 Dr. Majewski.

7 DR. MAJEWSKI: My question is not necessarily
8 directed to Mr. Dawson, but the EPA folks in general.

9 Many of the panel members will be sitting
10 through three of these SAPs and we are looking at three
11 chemicals and three models.

12 And my question is what is the ultimate goal of
13 the EPA looking at modeling fumigants or chemicals in
14 general? Is it to have an individual model per chemical?

15 Or is the ultimate goal to have some kind of grand
16 unified model to use for maybe just fumigants or OPs or
17 something like that?

18 MS. STASIKOWSKI: I will describe what we have
19 done with the probabilistic dietary exposure models,
20 because that's a good analogy.

21 We now have three models. They have been all

1 three reviewed by a Science Advisory Panel with comments,
2 changes and modifications. And we use and accept results
3 from all of the three models.

4 Within the agency, we will run the dietary
5 exposure assessment using a couple of models. And we see
6 sort of the similar approach here.

7 It is not that we are looking for one super
8 model or to find that one of these three models is just
9 the thing for all of the fumigants.

10 Right now we are looking at modeling bystander
11 exposure from fumigants. We may also look at these models
12 or other models and modeling exposure assessments for
13 bystanders from other types of pesticides.

14 But right now we would like to see each of these
15 models reviewed on its own merits.

16 DR. HEERINGA: That was Margaret Stasikowski of
17 the EPA. Mr. Jones.

18 MR. JONES: Jim Jones, if I could add a little
19 bit. We are constrained statutorily with deadlines and so
20 we are charged with using best available.

21 We have put forward the model that we have been

1 using and then the three additional models that the panel
2 is going to be looking at. And we think that the best
3 available is probably captured in that universe.

4 So it is not likely we are going to be able to,
5 as Margaret said, take any recommendations and create some
6 new model in the time available to us. We are mostly
7 likely going to be able to do some small tweaking
8 possibly to the best available we think we have put
9 forward.

10 Our ability to review all the three dietary
11 models is because through peer review they have all been
12 basically -- we have been told they are good estimators.
13 If the peer review had said these two are good, but the
14 third one is bad, then we probably wouldn't be using that
15 third one.

16 And similarly here, if after this process we
17 come to the conclusion after your advice that one of these
18 three models or two of these three models really are big
19 overestimators or underestimators, we'll take that into
20 consideration.

21 But I think what we are putting forward is best

1 available. Out of that we are hoping to be able to have
2 one or two or three models that we can use in our exposure
3 assessments.

4 MS. STASIKOWSKI: Some of these models just like
5 with the dietary models were not quite ready. And we
6 started our dietary exposure assessments with one model.

7 And as the other models were built, we have
8 introduced them as well. So some of these models may be
9 just fine, but may need more tweaking so that maybe they
10 will be available and acceptable in about a year.

11 Maybe after another SAP review. I just don't
12 know. But Jim pointed out that, yes, we do have a
13 deadline and we want to be able to use something before
14 the end of this year.

15 DR. HEERINGA: Dr. Majewski, does that answer
16 your question?

17 DR. MAJEWSKI: Yes, thank you.

18 DR. HEERINGA: Are there any other questions for
19 Mr. Dawson or Mr. Jones or Ms. Stasikowski?

20 Not seeing anything, I think at this point in
21 time I would like to move on to our main presentation.

1 Mr. Dawson, do you want to do the introduction?

2 MR. DAWSON: Sure. Now we'll be hearing from
3 Mr. David Sullivan, who is a consultant on behalf of the
4 metam-sodium registrant. He will be talking about the
5 FEMS model or the fumigant exposure modeling system.

6 DR. HEERINGA: Welcome to Mr. Sullivan. For
7 those of you who are looking at the agenda, there will be
8 a fairly lengthy presentation by Mr. Sullivan. It should
9 include some interchange with the panel for clarifying
10 questions and discussion.

11 At this point in time I would like to turn it
12 over to Mr. Sullivan.

13 MR. SULLIVAN: Thank you very much. I would
14 first like to start by saying I am grateful as is my
15 client to EPA for setting up this meeting and for all of
16 the members of the SAP that have taken the time to be
17 here, prepare your review and to help guide this model
18 hopefully to completion.

19 I would like to give you some background. I
20 think it will make your jobs easier. I am talking longer,
21 I apologize, if I sound longwinded. But I'm hoping by

1 providing as complete as an explanation as I can maybe it
2 will generate less questions later. We'll see how that
3 works out.

4 Let me start by giving you background. We are
5 using the EPA TOXST model. How did TOXST get written?
6 How is it used?

7 TOXST concept came out of the EPA Canaugh Valley
8 study. Do you remember Bhopal in 1984, 1985, whatever the
9 year was, Administrator Lee Thomas commissioned a study.
10 I managed that study for EPA at that time.

11 We looked at cancer. When the study was all
12 done, people said, that's well and good, but what about
13 acute exposures. So a second study was done on acute
14 exposures.

15 We developed the first prototype for TOXST at
16 that time. And the concept was for air toxics, much like
17 fumigants, exposures can be very intermittent. Emissions
18 can be very intermittent. And using deterministic
19 modeling cannot accurately capture the magnitude, duration
20 and frequency of exposure.

21 So we developed the prototype. EPA then later

1 took that concept and developed the INTOX model, then it
2 changed the name to TOXST.

3 Industry looked at the TOXST model at that
4 point in time and said, this doesn't work for us. It
5 doesn't handle things like batch sources. It doesn't do
6 multiple hour averaging.

7 So we developed a prototype for the Chemical
8 Manufacturing Association, later for EPA. And it became
9 the TOXST model. There is a lot of collaboration that
10 went on between industry and EPA to get to that point in
11 time.

12 The key point for that modeling system relating
13 to fumigants is the concept of a batch source.

14 At a chemical plant, a batch source's process
15 maybe is done four or five times a year. Create the
16 chemical. And when they do so, there is a random -- they
17 are not random, there is a very systematic series of
18 events that occur at that point.

19 They have to heat up the vats. Emissions may go
20 up, may level off and go down. But there is some sequence
21 to it, although the start is random. They may do three or

1 four a year. It is not always on August 5th at 9 in the
2 morning.

3 At that point, TOXST was written to handle a
4 batch source. The probabilistic part of that was limited
5 to the start of the application. Then a planned sequence
6 took place. There was no varying for uncertainty at that
7 point in time.

8 We took that modeling system and said, well,
9 this can be used for agricultural fumigants. They are
10 batch sources just as industrial sources are batch
11 sources.

12 They have a randomized start. Once they start,
13 emissions can go up and down, whatever sequence they
14 follow. Then it falls back to negligible levels. The
15 analogy is the same. It is the same concept.

16 My point is, in terms of the big picture, the
17 use of the ISC model with TOXST, they are both EPA models.
18 These have been reviewed.

19 There is a solution to modeling batch sources
20 that can provide frequencies that do represent the actual
21 frequencies you would get from that source considering how

1 many hours a year it would be operating.

2 Yes, a lot of the hours it has no emissions. In
3 this case for this batch we are talking about here, for
4 four days it has significant emissions. They go up and
5 down and then drop to negligible levels.

6 The point of TOXST and the point of FEMS is to
7 say we want to be able to represent that distribution
8 based upon considering the mass available -- considering
9 what actually would happen next to a field and create
10 distributions that do take into account frequency. How
11 often do these different things occur.

12 What we are trying to do is put in the hands of
13 the risk manager a distribution that they can look at it
14 from one of two perspectives.

15 They can look it from the perspective of what
16 happens over the course of a year for people living in
17 certain distances away from an applied field. They can
18 see that from the output.

19 Or if they want to say, I want to see what
20 happens just during the four-day period, they can process
21 the output to show that as well.

1 What if they want to know how often are we
2 getting concentrations above the no effect level divided
3 by 100. They can see that.

4 What about the risk manager that says, I want to
5 make sure that there is no times or it is like one in
6 several hundred years we go above the lowest effect level,
7 the IDLH level.

8 It's trying to put in the hands of the risk
9 manager a distribution that then they have the data in
10 front of them to go to the next level. But the main
11 point, it is based upon considering the frequency,
12 magnitude and duration of exposure.

13 That concept is consistent with EPA's guidance
14 documents on exposure assessment. That's what we try to
15 follow here. So the main message is the batch source
16 concept.

17 I will take the position that with EPA models
18 the state of the art to represent a batch source is ISC
19 with a TOXST model post processor. It is a post processor
20 to ISC. You can call it a model if you want to, but it is
21 a software package designed to take ISC output and make

1 it work for acute exposures.

2 So with that background, that's how we got to
3 this point. Let me also acknowledge that we had a lot of
4 help from DPR. I mean that sincerely, from Terri Barry,
5 Bruce Johnson, Randy Segawa. We brought this concept to
6 them.

7 They said, well, that's interesting, but you are
8 not really accounting for meteorological variability
9 uncertainty. And I also can say we weren't accounting for
10 emissions uncertainty either.

11 What we're here to talk about today and
12 tomorrow, the focus, in my judgment, is on the inputs. The
13 modeling system has been developed and reviewed.

14 But it is this probabilistic interface. We
15 didn't change TOXST. We didn't change ISC. We are just
16 processing the inputs to go into them.

17 That's how it evolved. But basically, what we
18 have developed in response to DPR appropriately is we took
19 the position, well, let's account for the variability in
20 the emission rates and uncertainty.

21 We don't really -- when we are not fitting

1 these lines, how ever we all end up doing it, whether it
2 be intercepts or transformed or whatever, that's an input.

3 There will be a consensus, and we will go with
4 that. But once that is in there, there is uncertainty in
5 those numbers. We want to characterize an uncertainty and
6 sample from it.

7 We do create multiple years, 200 years, base
8 years where we consider uncertainty in the emissions. But
9 also meteorology.

10 Meteorology are measured values, measured in the
11 case of long term assessment from off-site National
12 Weather Service, FAA, CIMIS stations.

13 I'm a meteorologist. I would like to be able to
14 say that our measurements are accurate and never wrong.
15 Kind of like the forecast. Our forecasts are sometimes
16 are wrong too.

17 Measurements are approximations. When we say
18 the wind speed is one meter per second or 10 meters per
19 second, that, of course, is an approximation. It has
20 uncertainty in it, as do all the inputs like that.

21 So we are accounting for that. Does it always

1 make a big difference? No. Does it sometimes make a big
2 difference? Yes, it does.

3 It depends upon the endpoint of concentration.
4 It depends on the averaging time. Also it depends on the
5 recurrence interval.

6 If you are looking for a rare event when all the
7 planets are aligned with Mars, if that's what you are
8 looking for, that makes a bigger difference, because
9 meteorological things like wind persistence, having a
10 situation with lots of wind persistence with low winds and
11 so forth, that kind of alignment won't happen every five
12 years, 10 years, 20 years.

13 But with a longer data set simulating and
14 pulling from the uncertainty, you can show that.

15 We are just trying to be able to take an
16 existing modeling system, bring in components that will
17 better account for uncertainty and emissions and
18 meteorology, and then provide output whether in the form
19 of distances to endpoint concentrations or ultimately we
20 could show distributions of concentrations and exposure.

21 That's what we are trying to do in the

1 discussions over the next two days.

2 So with that context, I'll go on. But are there
3 any questions with that approach, the basic use of those
4 two systems and what I have summarized so far?

5 DR. HEERINGA: Any questions from panel members
6 on the introductory structure for the FEMS model?

7 MR. SULLIVAN: The main point of this modeling
8 system really is to meet the needs of risk managers.
9 Also, hopefully, to meet the needs of agriculture as well.

10 But what are the needs of the risk managers? We
11 feel it is important to have accuracy in the sense of not
12 understating, not grossly overstating. I will say that
13 the FEMS system in this example I'm showing you here today
14 does err on the side of being overprotective.

15 It does tend to use emission rates that are on
16 a very high side compared to the rest of the country.
17 I'll describe that more later. But we do want to be
18 accurate within that kind of a context.

19 We want to make sure that we base our
20 distributions, our assumptions, our inputs on assumptions
21 that are plausible and distributions that are realistic.

1 Cultural practice. If the farmers have long,
2 skinny fields, we want to be able to model long, skinny
3 fields. If they have different application practices, we
4 want to have the empirical data to represent those range
5 of practices.

6 We want to make sure the farmers' positions are
7 taken into account as well. For sure we want to be able
8 to show the risk assessor data that has considered the
9 uncertainty in the inputs so they can see the sensitivity
10 to these inputs and get a better sense of what the numbers
11 really show them and tell them.

12 Lastly, the goal of this system is to have the
13 capability to handle any acute averaging time and to meet
14 the needs of any agricultural fumigants.

15 The way TOXST is structured, it is structured
16 due to any averaging time that divides evenly to 24. One,
17 two, three, six, eight and so forth. In that sense, it
18 does have that kind of flexibility built into it.

19 In terms of the goals of the system, TOXST is
20 developed by the Air office. And it has taken into the
21 account the philosophy of that office in a sense that in

1 developing acceptable concentrations they should protect
2 the most exposed individual, called the MEI.

3 What that concept really means is that in the
4 case of the buffer zones that any location outside the
5 defined buffer zone at or beyond that distance the
6 concentration should be less than the selected endpoint of
7 concentration for the percentile the risk managers chose.

8 That's the way it is structured.

9 We are trying to minimize any implicit
10 conservatism in the model. So by taking the analysis and
11 saying, look, if they apply metam-sodium, as an example
12 here, if they apply metam-sodium in a typical field once
13 a year, once every two years, sometimes less frequently
14 than that.

15 It is not applied a lot. So we do want to make
16 sure that the distributions that we put in front of the
17 risk assessor consider that fact. Making sure we're
18 putting distributions in front of him that have the right
19 mass that matches what they put out once a year.

20 So our distributions are based upon what would
21 be the exposure -- if this is the field we are looking at

1 right here in the center of these tables and the people
2 around that table, what would they be exposed to? For
3 example, at their place of residence or at the fringe of
4 that buffer zone over the course of a year, of a typical
5 year. What would the distribution --

6 You showed a 99.99 percentile down to the 50th
7 percentile. Whatever you want to show. That's the goal.

8 Now, you can screen these fumigants using
9 deterministic modeling. I'll give you a little bit of
10 background of why that's challenging to do that.

11 It's challenging to do that because -- first,
12 looking at the background, if a risk assessor truly
13 believed that a four hour or eight hour worst case
14 exposure to MITC, which is produced from metam-sodium, if
15 they assumed that was the same as a continuous annual
16 exposure to the same dose, the deterministic modeling
17 would work just fine.

18 You could take ISC, put in your worst case
19 emission rate, let it run, get an average, you will be
20 fine. You would show what the highs were and the averages
21 were and so forth.

1 But if the risk assessor doesn't believe that,
2 which usually is the case, health effects are a function
3 of exposure time as well as concentration, well, then
4 there is a reason to consider frequency as described in
5 EPA's guidance documents. Frequency is an important
6 factor that needs to be considered.

7 As I mentioned earlier in terms of the second
8 major point, it does provide the risk assessor with two
9 vantage points. Analysts (ph) have shown they can pick
10 percentiles that would be focusing on only the active
11 offgassing period if they want to.

12 If they want to look at multiple fields at the
13 same time, they can pick the percentile on that basis as
14 well. We want to put the decision in their hands and not
15 make any assumptions for them or minimize any processing
16 before they make their decisions.

17 We are trying to give them distributions. I'm
18 showing this field. This is a typical kind of a fumigant,
19 what it looks like before you put a fumigant down.

20 I'm going to start by giving some folks some
21 background that aren't familiar with fumigants. I'll

1 admit that six years ago I started working on this in this
2 area. I had to look up things like what is a nematode.

3 They didn't teach us that in meteorology school,
4 what a nematode was. These products kill nematodes.
5 Little worms that eat at the roots of developing crops and
6 affects the yields and quality.

7 They are also put in there to control weeds and
8 disease. Why that is that important? Well, it is
9 essentially important to agriculture, because, if you have
10 your seedlings trying to get started and they are being
11 nibbled at and they are being affected by disease, they
12 don't grow too well.

13 A fumigant gives them a good start. All these
14 fumigants are designed to do that. And so it can increase
15 the yields substantially. Also increases the quality of
16 the products.

17 So there is a reason the grower does have a
18 benefit from using this chemical. I want to make that
19 point clear here. This field looks like a very simple
20 source to model. I'm a modeler. I have been modeling for
21 30 years.

1 I was asked to do a study on metam-sodium six
2 years ago. I thought it would take about a month to get
3 it done. Six years later we are still working on it.

4 It is more difficult to model this field than to
5 model the Washington, D.C., metropolitan area for 200 air
6 toxics. I used to do that for EPA, Urban Air Toxics
7 Assessments. That's easier.

8 You have inventories. You process the data, you
9 collect the measured data. That's doable easily.

10 This is harder. Because that field is very --
11 it is deceiving. It looks like it would be simple to
12 model that source, gasses coming off. What is the
13 problem?

14 The problem is that there is dynamics going on
15 between the soil and the air. And Scott's right. It is
16 not really a black box.

17 A lot is going on beneath the ground. And how
18 you apply these chemicals makes a huge difference what the
19 offgassing magnitudes are and timing, when the peaks come
20 off.

21 Water, for example, affects the heat capacity,

1 heat conduction. Affects the porous space. These are all
2 complicated variables that end up producing situations
3 where some of these applications, if they are done a
4 certain way, can have 30 fold lower off-gassing rates
5 during critical time periods.

6 So it is not a simple source. That's why we
7 have taken the approach, as did Dr. Reiss and as DPR, that
8 because of the complexities at this point in the state of
9 the art it is best to address this from an empirical point
10 of view.

11 So we definitely are characterizing the fields'
12 off-gassing rates empirically at this point in time.

13 Now, when you do that empirically, there is a
14 natural question that comes up. The question is, well,
15 you did this at X number of locations in the United
16 States. Then you are trying to extrapolate this to the
17 country. How can you do that.

18 I want to make this point very clear, that, in
19 my judgment, the way to do that is to start by going to
20 the place that would be about the worst that you could go
21 to.

1 What is the hottest, driest, worst place you can
2 go to? Well, there are two places come to mind that I
3 have been to. One of them is Bakersfield, California,
4 during the heat of the summer. The other is Yuma,
5 Arizona, during the heat of the summer.

6 Anyone who can go to those two places and say,
7 this isn't the worst place, it must be worse somewhere
8 else, unless they are farming in Death Valley, maybe they
9 are, I don't know, but that is about as bad as it can get.
10 There may be some place worse, but I'll say, I don't want
11 to go there.

12 What happens when you do a study in these
13 conditions in the summer in Kern County? Well, in the
14 morning it is just below 90 degrees. What is it like in
15 the afternoon at this study? It is 105.

16 Then it gets windy in the afternoon to dry out
17 your water. And there is not that much carbon in the soil
18 to absorb the chemical. We are taking the position that
19 to start a database, start the database in the worst
20 location, get your sampling method sampled there.

21 And you will, in my judgment, tend to overstate

1 the exposures when you take this to the pacific Northwest,
2 when you take it to the southeast or the Great Lakes --
3 for two reasons.

4 The main reason is temperature. The secondary
5 issue would be the soil texture. You see sandy loams,
6 sandy type soils out here in California.

7 So that's the position that has been taken here.
8 It is an important distinction.

9 Later, when more data is available, and if the
10 registrant wanted to reduce buffer zones, perhaps, for
11 different seasons, different locations, certainly have the
12 right to get more data and collect data on cooler
13 conditions, heavier soils.

14 I'll show you data that will show you a dramatic
15 difference in off-gassing when you do that, tremendous
16 difference, factor of 30 difference.

17 But as a starting point, it is critical to start
18 here as we have done.

19 I just want to give you a little bit of a
20 primer. For some people this may be -- you have seen this
21 all before, but how is metam-sodium applied.

1 It can be applied by center pivot. There are
2 several ways center pivot can be done. Basically, it is
3 going to go around. It will take a couple days, perhaps,
4 to go around a big circle, as a big area, that way. It
5 is spraying as it goes around. That's one way to apply
6 it.

7 The second way is chemigation. This is an
8 active chemigation in progress here. That's where they
9 have irrigation lines, that I showed in the earlier
10 picture, irrigation lines going a half mile north, south,
11 typically, in California.

12 They will use the irrigation lines to apply the
13 product in dilute form. When it's all done applying, they
14 will turn on the water to do what is called a water seal.

15 And just another beautiful shot of chemigation.

16 It is also applied by shank injection, by a
17 tractor with injectors to inject it into the ground.
18 That's another way it is applied.

19 When that's done that way, the sealing of the
20 surface can be done generally three ways, one way is to
21 use water sealing. They can put the tractors through the

1 lines and then close up the lines as they get done, turn
2 on the water behind them and seal that off with water.

3 You can also put a tarp right behind this going
4 down.

5 And the third way, which works very well in some
6 locations, is compact the surface with big power rollers.

7 It's a nice, smooth, hard surface. That's how that tends
8 to be done.

9 And the last slide here is by drip irrigation.
10 Usually, growers don't have sampling probes in their beds
11 like this, but just envision a tarped bed, usually tarped,
12 not always, and either buried or surface drip lines.

13 They use less water that way. They will drip a
14 chemical in for maybe six hours or so that way as well.
15 Those are the major ways that metam-sodium is applied.

16 Before I do get into the slides, I do want to
17 describe a concept that's going to come up over and over
18 again. That's a concept of intermittent sealing.

19 To give you more background, intermittent
20 sealing was developed about four years ago. And the
21 concept is based on this, that -- as a meteorologist, my

1 concern with fumigants was as the inversion is setting up
2 at night and during the nighttime period dispersive
3 characteristics are, about, let's say, 25, 30 times more
4 restrictive at night, typically, than the daytime.

5 If you have a situation where you are peaking
6 your emission rates at night, that's not a good thing for
7 buffer zone distances or exposure.

8 Reviewing the earlier studies that were done,
9 the first two studies that were done in '99, that's what
10 we found. That as things dried out at night, the soil
11 aerodynamics were such that we were getting very much
12 higher concentrations at our monitors, much higher
13 emission rates that were fitted to the data.

14 That's the last thing you want to see. You
15 would rather see your peaks, whatever they are, in the
16 daytime and damped down emissions at night to minimize
17 exposure. Nighttime exposures generally will be the
18 limiting factor.

19 The Metam-sodium Task Force sponsored research,
20 starting with the laboratory, into policy studies, into
21 full field GLP studies, where it tested the concept called

1 intermittent sealing.

2 All that really means is -- let's say you are
3 doing chemigation application. You put your product in
4 over the six hours. Put in a couple of hours of water
5 when you are done. Let's say you are done around 2 in the
6 afternoon, which is about ideal. It is drying out.

7 Now the wind picks up in California. It is
8 drying out. The inversion is coming up as it is dried,
9 the surface has dried off quite a bit.

10 Intermittent sealing concept was come back an
11 hour before sunset, put down a quarter inch of water. Come
12 back four hours later, put a second quarter inch of water.

13 On day Number 2, repeat those two nighttime
14 steps.

15 Sprinklers are already in the field in
16 California because it is not that -- it is significant
17 work for the grower, but they can do it.

18 What that does is essentially, I won't say turn
19 off, but almost turn off emissions at night. Why does it
20 do that? A number of reasons, and Scott could talk about
21 it in greater detail than I.

1 But you are filling up porous space. You are
2 affecting the heat capacity. You are more preferentially
3 evaporating water rather than MITC.

4 And maybe most importantly, you are maintaining
5 a large enough water reservoir to maintain the MITC in
6 solution rather than flash it off.

7 Now, when I talk about MITC, let me give you a
8 background. Metam-sodium is a salt. It is nonvolatile.
9 Metam-sodium is put in liquid form.

10 Once it is in the soil, in a moist soil, it will
11 convert fairly quickly. In a typical hotter temperature
12 soil, 30 minutes or so. It converts into methyl
13 isothiocyanate. We'll just call it MITC.

14 That is the actual lethal agent for nematodes,
15 weeds and disease. That's what's doing the work. So it's
16 MITC that we will be talking about the rest of this
17 presentation.

18 And I have mentioned already this point that is
19 shown here. The purpose of all fumigants is to solve
20 these three problems, ideally.

21 Metam-sodium, with rare exception, is put down

1 prior to application. Put down in a flat, unplanted
2 field, flat, it would be bedded in some cases, sometimes
3 put in a flat, but it is put down preplant.

4 It does convert to MITC and some other minor
5 constituents. MITC will then degrade. Biological --
6 biodegradation is often in a period of seven days, 10 days
7 and so forth.

8 The concept of minimizing exposure is to try to
9 keep the MITC in the soil long enough to degrade rather
10 than lose most of it through volatilization.

11 Now, in terms of the design objectives for FEMS,
12 the issues I'm showing here are issues that are important
13 to the grower. What is important to the grower is
14 flexibility.

15 With the grower, we want to avoid -- if there is
16 one part of the United States that has the worst case
17 meteorology and you are using the worst case emission rate
18 surface of the country, that's bad for the grower.

19 They want to see flexibility. Can you show how
20 things are regulated by season and region. Ideally, that
21 would give them more flexibility and would be more

1 efficient.

2 But there are things like accounting for the
3 size of the application. That's important. Accounting
4 for the application rate, application methods. And the
5 bottom issue will come up, and it is important, what about
6 when there is multiple fields involved. What about these
7 four growers that have adjacent properties.

8 FEMS can consider that factor. And what about
9 the grower that is doing a very large 160 acre field over
10 eight days, 20 acres at a time. It can cover that issue
11 as well. But that's practical what happens in the field.
12 They need to be able to address those problems.

13 I mentioned the first two bullet points
14 already. In terms of the third and fourth, there has been
15 some confusion at some points about are we just randomly
16 sampling meteorology. Are we randomly sampling emissions.

17 No. We are putting those information in
18 sequentially as they are collected. We are randomly
19 sampling with the uncertainty.

20 We are perturbing the uncertainty distributions.
21 That's what is happening in the set-up of the runs for

1 TOXST.

2 Also, the goal in terms of the objective is to
3 identify the endpoint distances within 10 meters. And we
4 do scale up.

5 I have mentioned some of these points already.
6 I do want to make the point that in the coding structure
7 of FEMS we have included an indoor modeling component.
8 That's not up for review today.

9 That was just coded in there as a place saver.
10 It certainly can be linked up and assumptions tightened up
11 to give an indication of expected, both personal exposure,
12 as well as indoor exposure. But it is not the subject of
13 today's discussion.

14 For database perspective, this point has been
15 made, but, again, the objective is to start on the high
16 side in terms of emissions and fill in the matrix of soil
17 types and conditions over a period of time.

18 All the different models you are hearing are
19 talking about fitting emissions information using models.

20 There is one assumption I do want to make clear that is
21 important to all of them.

1 That's a concept of how well -- is the model
2 results known well enough to support the emission fitting
3 procedure? Because when you are doing -- for example, you
4 use least square's regression, you're using that approach,
5 you are assuming uncertainties in your fit, in your slope.

6 You are assuming the model is pretty good and
7 the measure data is pretty and you are looking at the
8 uncertainty of emission term. How well do these Gaussian
9 models really work?

10 Well, if you look over the testing EPA has done
11 over the years, you come to the conclusion as the Air
12 Office has that, well, it depends upon your perspective.

13 If you want them to perform to show you what the
14 concentration is at the intersection of Constitution and
15 14th Street on June 3rd, 2004, they work terrible. If you
16 constrain these models in space and time, they don't work.

17 But what the models do a quite a good job, and,
18 actually, surprisingly good job at is estimating maximums
19 and distributions over a period of time.

20 With that in place -- like I say, I feel okay
21 about using the models for that purpose. But it is

1 distributional approach.

2 I'm not saying that the emissions data we are
3 fitting are right period by period by period and get the
4 sequence exactly right. But I'm saying the distribution
5 is reasonable on a daytime and nighttime basis.

6 It doesn't matter to TOXST if the sequence is
7 right in terms of the four hour blocks we're working with.

8 But what does matter is the diurnal periods covered, and
9 we are covering the range of conditions that all happen in
10 the daytime and the nighttime.

11 So I do not want to define success as hitting
12 the emission points one by one and the concentrations one
13 by one. But the goal is the distributions. That's what
14 we are looking for, is to be able to give a distribution
15 in the end to the risk manager.

16 Well, by the same concept, our information going
17 in should be accurate in distributional form as well.

18 Again, the point I may have touched on is we
19 want to make sure that the regulatory decisions are based
20 on realistic distributions of exposures that a person
21 living or spending significant time around that field will

1 be exposed over the course of a typical year.

2 And this is just an example of the challenge of
3 deterministic screening. None of the models being
4 presented to you are screening models. But in terms of
5 the screening model, using ISC as an example, the
6 chemigation, intermittent sealing field study that I'm
7 referring to throughout this presentation, which was done
8 in Kern County in the summer of 2001, there was 179 pounds
9 per acre of potential available MITC.

10 That's how much was put down. That's the most
11 you can release, 179 pounds.

12 And when we did our assessment, we computed we
13 lost 23 percent, lost 42 pounds during the four days. At
14 that point we are down to negligible emission rates.

15 What would happen if we made the assumption that
16 let's use the highest four hour period, highest four hour
17 emission rate, and, for screening, assuming that happened
18 all year long. That's a reasonable screening procedure.
19 That's a reasonable first step.

20 But what happens when you do that in this
21 example is the amount of mass lost is way more than the

1 amount you put down. How much difference?

2 Basically, if I took the four hour max from that
3 study and assumed that happened all the time for the year,
4 I would emit 26,000 pounds of MITC. About 620 times more
5 mass than was available if none had biodegraded, none had
6 volatilized.

7 So that's why I do commend EPA for taking the
8 time and effort to go into probabilistic modeling to
9 address this problem. It is really is needed.

10 How it's done and what inputs you use and how we
11 fit all this emissions information, I hoping there will be
12 consensus, and I expect there will be, of how that can be
13 done.

14 This modeling system once that is completed can
15 be used using off-the-shelf EPA modeling tools to assess
16 these exposure distributions.

17 Now I'll get into assumptions at this point. The
18 first assumption I have discussed. Actually, I have
19 discussed these three. But to summarize, we are starting
20 high. We are starting with locations that are indicative
21 of maximum expected emission rates. That's the starting

1 point.

2 The distributions of emissions and
3 concentrations are the key input. Lastly, distribution
4 should be mass conserving.

5 When a risk assessor looks at the distribution
6 of exposure or whatever, should be based upon a realistic
7 consideration of available mass.

8 Scientific assumptions that were made. The
9 first one is controversial. We'll get into this more
10 later. Should you log transform or not.

11 I'll describe to you how I did it specifically.

12 And if there's (ph) a better way to do it, we'll go
13 there.

14 I'll tell you why I did it. We'll discuss it.
15 Again, what we're searching for is -- I'm happy this group
16 convenes so we can resolve these issues, identify the best
17 way to do these things and then have -- ideally get the
18 people involved like Terri Barry, myself, Rick Reiss and
19 also EPA and its consultants in a room and take the report
20 you folks provide and harmonize this so we do have a
21 method, an objective method that we all use. That should

1 be the goal.

2 But our assumption is based on the
3 transformation. I'll describe why. We are assuming the
4 Gaussian model is okay, which I think is a pretty well
5 accepted assumption.

6 On our test case, we are using five years of
7 meteorology. That generally is considered sufficient for
8 deterministic modeling.

9 We are taking that five years, and I'll describe
10 later, we are creating 200 years based on sampling the
11 uncertainty in that data set. We could equally have taken
12 10 different five year data sets and put them back to back
13 for a region and done it that way, too, and account for a
14 wider range of uncertainty. But it is based upon actual
15 measured data to start with.

16 And lastly, we are assuming that the field we
17 are applying is homogeneous. Emission rates are constant
18 throughout that field. We know that's not true, exactly.
19 There is variability.

20 On these fields I showed, it looks like it is
21 all the same. Nothing is the same in those fields. The

1 water distribution is different. The soils can differ
2 within that field itself.

3 But we are using the ambient back fitting
4 approach to describe here. A key benefit of that
5 approach is looking at the composite plume.

6 In a composite plume sense, assuming uniformity
7 and the emission rates is a pretty good assumption, in my
8 judgment.

9 In terms of the third bullet point, assumptions
10 for least squares emissions, we are assuming that the
11 modeling and measured data are reasonably accurate and
12 that the bulk of our uncertainty is in the slope term that
13 are using to fit the emissions.

14 But also requires that the residuals be normally
15 distributed and there be constant variance. One of the
16 reasons that we did transform the measured data and the
17 model data prior to computing the least squares fit was to
18 get a more normally distributed set of residuals, which
19 that did do.

20 That ends the introductory portion. I'll get
21 into more details on those things, but I do want to pause

1 and ask if there are questions before we go into the more
2 details on all these things.

3 DR. HEERINGA: Are there questions from any of
4 the panel members on the introductory portion of Mr.
5 Sullivan's presentation?

6 DR. WANG: One of the slides you described the
7 experiments, applied the 179 pounds of potential MITC
8 after conversion?

9 MR. SULLIVAN: Yes.

10 DR. WANG: How did you deal with the conversion
11 factor?

12 MR. SULLIVAN: That's assuming -- the maximum
13 label rate is 75 gallons an acre of metam-sodium. That's
14 about 320 pounds of active -- of metam-sodium in there.
15 And we're assuming stoichiometric, 100 percent conversion
16 into MITC, which studies show around 90 percent is usually
17 what you tend to see in terms of converted.

18 We're assuming 100 percent of the potentially
19 available will be lost.

20 DR. WANG: So assuming that basically you have
21 -- you apply 179 pounds of metam-sodium per acre and

1 assume they all converted to MITC? Is that --

2 MR. SULLIVAN: No. We are assuming that 320
3 pounds of metam-sodium per acre are applied, and the
4 stoichiometry is 73 to 129 difference of molecular
5 weights, and that would get you down to 179.

6 MITC is 73 grams per ml. And metam-sodium is
7 129. That's basically how that was done.

8 DR. HEERINGA: Other questions? Dr. Yates and
9 then Dr. Baker.

10 DR. YATES: In one of your slides, you were
11 showing chemigation sprinkler. I guess what you are doing
12 in that is you are sprinkler spraying the metam-sodium,
13 and then when it lands on the field the idea is that it
14 transforms to MITC?

15 MR. SULLIVAN: Yes. The way it works,
16 typically, a grower will turn on the irrigation sets with
17 pure water in the beginning, let it run for whatever.

18 Then turn on the injector pumps, put the
19 metam-sodium in there. Of course, it's in dilute form,
20 but it is in that mixture. That will then be sprinkled on
21 to the surface -- height, about 18 inches off the ground

1 or so. And that's done over six hours.

2 It's settling, it's working its way down into
3 the soil over time. It converts in the soil to MITC.

4 DR. YATES: You are saying what, now, about 18
5 inches off the ground?

6 MR. SULLIVAN: The height of the risers, these
7 irrigation lines on the ground, risers, they come up about
8 18 inches or so. They are like you have in your yard, the
9 little sprinklers that go around. It is sprinkling --
10 they are overlapping sprinklers.

11 DR. YATES: Right. But the spray is up quite
12 high in the air.

13 MR. SULLIVAN: I showed the picture. It can go
14 five, eight, ten feet in the air. Yes.

15 DR. YATES: Because metam-sodium, it converts
16 relatively slowly, I have to emphasize the word
17 relatively, in water, but there are other things that can
18 cause a very, very rapid reaction.

19 For example, metam-sodium reacts with the other
20 halogenated fumigants in the matter of minutes or seconds.

21 If you would inject metam-sodium with, say, chloropicrin,

1 it is all MITC when it is coming out the nozzle.

2 There are also other things like metal species,
3 oxides and that that cause a very rapid reaction. So if
4 you had your injector tank, if there is rust in there,
5 there could be lot of conversion that's occurring inside
6 the tank prior to being sprayed out.

7 I think there is also some pH effects as well.

8 MR. SULLIVAN: The label does have restrictions
9 in metals that can be used with it. You can (ph) apply
10 metam-sodium in the other fumigants at the same time.

11 But if you are applying metam-sodium and
12 chloropicrin, which is done, they have to be separated in
13 time or space. You can inject your metam deep and your
14 chloropicrin on top or you can put your chloropicrin in
15 first and follow it up with metam.

16 But together, they neutralize the benefits. The
17 pH problems and all the rest doesn't work that way. They
18 have to be separated.

19 DR. YATES: Right. But have there been any
20 studies looking at when the spray is actually going out to
21 see if during the sprinkler period you are getting a lot

1 of either drift or off-site movement of MITC?

2 MR. SULLIVAN: Yes. The actual -- the
3 monitoring networks, which I'll show, are turned on prior
4 to the beginning of the active application in samples I
5 collected during the application itself to determine what
6 are the concentrations at that point in time.

7 Also, we have done an assessment of droplet
8 movements and so forth to assess that factor. And the way
9 the pressures are done, relatively lower pressures and
10 droplet nozzle sizes tend to minimize the drift issue as
11 well.

12 It is falling off quite rapidly, it's
13 volatilizing, and the monitors are around the field to
14 capture that right from the moment that the application
15 begins.

16 DR. YATES: You are not seeing the real large
17 concentrations in off-site during the sprinkler phase?

18 MR. SULLIVAN: It depends upon how you are
19 sealing and so forth. But you are not seeing real high
20 numbers then. I'll show you examples later on during the
21 active phase.

1 In some cases, it will be -- it can be your
2 highest emission rates, depending upon how you are
3 applying.

4 DR. YATES: Right. Because the only thing
5 really helping you, if it does convert to MITC, is that it
6 has a very low Henry's concen (ph), so it tends to
7 partition into the water phase, which would help to --

8 If it was another one of the fumigants, there
9 would be a lot more chance for getting into the air and
10 leaving during the sprinkler phase than MITC. That
11 happens to have the lowest Henry's concen of all of the
12 fumigants. So that works in its favor.

13 MR. SULLIVAN: It does. It is happy being in
14 water. That's why the water reservoir concept, the extra
15 seals, they work really well for metam-sodium because it
16 has enough water. It wants to stay there.

17 When it starts drying on top, it is going to
18 flash off and be gone.

19 DR. HEERINGA: Dr. Baker.

20 DR. BAKER: I had a similar type question. When
21 I first read this, my feeling of the concept was that

1 physical processes were rate limiting in terms of the
2 emissions.

3 I was wondering now thinking about the chemistry
4 could there be some cases where the chemistry of the
5 conversion is a rate limiting? And if so, is that
6 chemistry well understood first order, second order type
7 chemistry?

8 MR. SULLIVAN: It is understood I think fairly
9 well. There have been research studies on that. The
10 label restriction on when metam-sodium can be applied,
11 temperature restriction, your surface temperature can't be
12 less than 40 degrees or more than 90 degrees. There is a
13 window.

14 If you get really cold temperatures, it will
15 convert very, very slowly and will not as effective. If
16 you get above 90 degrees, it could be that it is too rapid
17 or it may affect the product, the chemistry itself. I
18 don't know.

19 But that's the window. The breakdown has been
20 studied -- in typical, moist, typical warmer soils, it may
21 convert in 30 minutes or less, it may convert in an hour

1 or two.

2 But in the general scheme of things, it is
3 pretty fast. Once the MITC is in the soil, it can break
4 down, it varies in literature, five days, 15 days.

5 But it follows a first order decay. Then what
6 the literature shows, often times after three or four
7 days, it follows a new decay rate that is much more
8 accelerated. Than can be due to the fact that it's going
9 to -- it will be lower concentration. It will go down
10 much faster, dual phase decay.

11 DR. HEERINGA: Dr. Seiber has a question.

12 DR. SEIBER: I appreciated your comments about
13 Bakersfield. I live in the great central valley. So I
14 understand that that is kind of a worst case situation.

15 Another unusual thing, sort of, about
16 Bakersfield and the San Joaquin Valley is high ozone
17 levels. It is an ozone non attainment area, I believe, in
18 EPA terminology.

19 My question is more on the chemical reactivity
20 and fate stability, if you will, of MITC in that field
21 situation. And more specifically, as MITC gets into that

1 intermittent water seal and the next day comes along, the
2 sun comes up and ozone levels go up, is that a
3 consideration, is there breakdown?

4 I'm really getting at the material balance,
5 because your material balance, that's a goal of the model,
6 but it doesn't seem to add up to 100 percent of all the
7 MITC that is theoretically applicable. I want to know
8 where the rest of it goes.

9 The other place in the air downwind if there is
10 any atmospheric conversion of MITC.

11 MR. SULLIVAN: In terms of the atmospheric
12 conversion rates of MITC, it will break down in the
13 atmosphere. Half lives is I think in the order of a day
14 or more, though.

15 The travel times are in the matter of minutes,
16 5 to 10 minutes at the most. In terms of decay losses
17 over the domain of interest here, it is pretty small.

18 In terms of mass balance, and I'll get more into
19 this later, but we found that in doing the intermittent
20 sealing concept, over four days we will volatilize off
21 about 20, 23 percent of potentially available MITC.

1 If we go with the other approach, it can be
2 anywhere from 55 percent to 86 percent. So that's the
3 range we have seen. My expectation is that the portion is
4 not lost by volatilization. It is lost primarily by
5 biodegradation in the soil itself.

6 What the extra seals do, we wondered at first,
7 would it go back up again if we stop sealing it on days
8 three and four, but it did not.

9 It seemed at that point that now biodegradation
10 had kicked in to some extent. It had pushed the material
11 down deep enough in the soil that it didn't resurrect into
12 higher concentrations later on.

13 DR. SEIBER: Or maybe chemical degradation? You
14 said biodegradation. Could that be a factor too?

15 MR. SULLIVAN: I suppose it could be. From the
16 literature I have read, it seems that biodegradation may
17 be the most important driver. But certainly it is
18 possible.

19 We do have an expert, a chemist, from Amvac, one
20 of the manufacturers here that can answer it if you want
21 more details on that at any point.

1 DR. HEERINGA: Dr. Ou.

2 DR. OU: This follows Dr. Wang's question. I
3 know that one molecule of metam-sodium contain two
4 molecules of water. They hold (inaudible) weight for the
5 metam-sodium. If two water molecule include weight be 165
6 and you convert to the MITC, if two water molecules
7 included, weight beyond 44 percent, not 57 percent.

8 MR. SULLIVAN: What percent of MITC will convert
9 from metam-sodium --

10 DR. OU: From metam-sodium, because metam-sodium
11 contain two water molecule.

12 MR. SULLIVAN: Stoichiometrically, it is
13 approximately 60 percent. If you applied 100 pounds of
14 metam-sodium, you would have potential of losing about 60
15 pounds of MITC.

16 DR. OU: I understand, one metam-sodium. Some
17 chemical contain water.

18 You buy metam-sodium from chemical supplier. It
19 contain two water molecule. They are holding (inaudible)
20 weight where it would be 165, not 129. They hold
21 conversion weight 44 percent, not 57 percent to MITC, if

1 assume that 100 percent conversion.

2 MR. SULLIVAN: Being a meteorologist, I kind of
3 know when to be quiet here. I'll turn it over to --

4 DR. HEERINGA: Let me suggest that -- there are
5 some questions of chemistry, and what I would prefer, I
6 think, is that if, unless they are absolutely essential at
7 this point, and I will defer to the panel, that what we
8 would do is let Mr. Sullivan make his presentation on the
9 model and then provide an opportunity at the start of the
10 public comment period for a representative of the
11 manufacturer to address an overview of some of the
12 questions on chemistry and then also have some interchange
13 at that point, if that's agreeable to the panel.

14 Not being a chemist myself, I want to make sure
15 that I'm not shortchanging anything that is important to
16 your interpretation of the model.

17 But I think if we could do that, I think it
18 would make sure that we keep the flow and also but get
19 specific attention to critical elements of the chemistry
20 of the compound too.

21 Is that agreeable to all the panel members? Yes.

1 Dr. Winegar, you also had a question.

2 DR. WINEGAR: Mine was a chemistry question so I
3 can wait until that time.

4 DR. SPICER: Mine was a chemistry question also.

5 DR. HEERINGA: We have a lot of chemists who are
6 stimulated by this. Are there any other questions for Mr.
7 Sullivan at this point?

8 Please continue. I would like your help on one
9 thing. And that is we are going to search for a break.
10 Ideally, that break would occur somewhere between 20
11 minutes and 30 minutes from now. But I will let you
12 choose the appropriate time in your talk to do that. If
13 you go to 40 minutes, I will cut you off.

14 MR. SULLIVAN: Thank you. Please do. I will
15 happily defer to Dr. Feiler these chemistry questions. He
16 will handle them better than I.

17 My presentation is structured into these major
18 heading categories. I will go through them one by one. I
19 won't give an introduction right now. I'll start with the
20 Monte Carlo variable in FEMS, then get into the emission
21 fitting procedure. That will be what I'm hopeful we can

1 get through this morning. In the afternoon it will be the
2 other three items.

3 Again, in terms of the original version of TOXST
4 in the sense of a batch source like this, the only aspect
5 that is probabilistic is the start. The start is
6 triggered in a probabilistic basis; based on a probability
7 for a start that's entered by the user. That's also done
8 here.

9 But the additional feature is that we have
10 incorporated into the model now emission rates and
11 meteorological parameters. That's been done now. We have
12 shown in the back of our report what could be done.

13 And it depends upon interest and whatever. But
14 in the end, the receptors probably should be Monte Carlo
15 as well, because subject weight, breathing rates that
16 enter into milligram per kilogram per day also can be
17 addressed in distributional form by area (ph) of
18 distributions.

19 I'm not saying it does this now, but I'm saying
20 it creates output in a manner that would support that
21 level of analysis to show the function of distance from

1 the field what the distributions would look like from
2 milligram per kilogram per day for the children and the
3 adults.

4 Not the subject of today's discussion, but
5 that's just background.

6 Because of the intermittent nature and
7 infrequent nature of these releases, it is important in my
8 view that the modeling system consider how many hours a
9 year this source is operating.

10 Like I said, some growers, typical situation
11 once a year, they will hit the field with metam-sodium or
12 other fumigants. Some growers of the old school do it
13 every four years, five years, let things settle back down
14 again.

15 If they are applying once every five years and
16 there are four days of off-gassing, that's important to
17 consider.

18 If they are doing it once a year -- sometimes in
19 Florida they double crop, they may do it twice a year.

20 Maybe it goes to three times. I have never
21 heard of that, but maybe it is possible. But there is

1 variability. And that variability should be considered in
2 the analysis.

3 The example I'm showing you now is taking care
4 of the variability and the uncertainty in meteorological
5 variables on a yearly basis. This is for the example
6 case doing yearly.

7 You can argue, well, is there an equal
8 probability they would apply metam-sodium in California
9 any time of the year? The answer is no. There are
10 certain growing cycles they are trying to match up with.

11 It can equally be done in custom runs right now
12 using seasonal data. Ideally, you could use monthly data
13 if you needed to to make sure the meteorology matches the
14 crop or the crops being evaluated.

15 But for now, it is just doing the random --
16 TOXST was only doing the random start. So when we are
17 designing how to use TOXST with agriculture, we have a
18 little bit of a challenge because the problem is that we
19 could have a random start, turns on the batch and does its
20 thing, but I may randomly turn that on at 3 o'clock in the
21 morning.

1 The empirical data and the structure is based
2 upon assuming a start shortly after sunrise. So we would
3 have a diurnal mismatch. Turn on -- the emissions thinks
4 it is 7 -- 10 in the morning. Meteorology thinks it's 3
5 in the morning. We have a mismatch. Not good.

6 So the concept that was used in bringing the
7 TOXST in line for a fumigation application was simply to
8 say, well, look, we are going to assume that in ISC it is
9 always going through the cycle over and over again.

10 In this case, we have a four day off-gassing
11 period that's being evaluated. It's going through 96
12 cycles. When it gets to the end, it goes through it
13 again. It does it over and over again. 200 years.

14 So when TOXST, based on a probability the user
15 puts in, says start your process, it is like engaging a
16 clutch in a standard car. The motor is always running,
17 but now we are engaging the clutch and now the data is
18 being fed into TOXST.

19 It picks up and it is a cycle that's 3 o'clock
20 in the morning. Maybe a 24 hour period is being assessed
21 in emissions. Maybe that's period 16. It is going to run

1 through period 16, properly match the meteorology through
2 17 through 24, go back to 1 again so it is matched
3 diurnally and then go to the ending point period 15.

4 So it's going to do an entire loop, entire
5 cycle. It will keep it diurnally matched. We care about
6 the frequencies. We care about the numbers, not the
7 sequence that they come in.

8 So distributions will work, but the cycle's
9 completed in that manner. That allows us to not change
10 TOXST, but to just change how the output out of ISC was
11 generated.

12 That's the most significant change. Doesn't
13 sound that big a deal. It took a little time to figure
14 that part out. But that's one significant change in using
15 TOXST for agricultural sources.

16 Again, I want to repeat because it is a
17 confusing concept. We are having all the emissions
18 variability and uncertainty in ISC. When we create the
19 ISC files, we are perturbing the meteorological data
20 uncertainty, emissions data uncertainty over 200 years.

21 We're creating 200 years of input files, hourly

1 emission files, meteorological files in ISC. ISC is going
2 through the emissions sequence over these 24 periods over
3 four days for the appropriate application and same method
4 being evaluated.

5 So always going to run that sequence. When
6 TOXST triggers a start, it will engage that sequence, pull
7 off 24 four hour periods of data properly matched on a
8 diurnal basis.

9 So the 3 in the morning emissions is matched up
10 with 3 in the morning for meteorology. Then it is a
11 straight TOXST run off the books from EPA.

12 You see, again, the heart of my presentation
13 today -- this is an EPA model I'm using. The part that's
14 different in these flow charts which I will show later I
15 have highlighted in red.

16 Those are the parts where we need your help the
17 most. You can comment on anything you want. I'll be
18 happy if you do.

19 The areas about how do I address the variability
20 uncertainty in meteorology emissions, that input, that's
21 key. If there is a better way to do the emission

1 fitting, we would like to change.

2 If there is a better way to do the
3 meteorological variability, we'll go there. But it is the
4 emissions data that's input the most critical in my
5 judgment for the review.

6 Emission fitting, this is the fun part of this
7 whole job. And many of us have been working on this for
8 five or six years, I'm ashamed to say, but still working
9 on it.

10 There is not an easy clearcut answer to how to
11 best fit emission rates for these fields. I know three
12 ways that can be done. My expectations is all three ways
13 can provide very satisfactory results when done properly.

14 We are describing here today backfitting based
15 upon ambient monitors being placed around the field.
16 That's one way to do it.

17 We are fortunate to have Dr. Yates in the panel
18 that's an expert on surface monitoring. Flux chambers,
19 profile sampling, that can give you another way to
20 estimate emission rates as a function of time.

21 The third way is remote sensing. It may work

1 for some of the fumigants. It likely will work for MITC.

2

3 The spectra is such that that probably does have
4 a good signal. It won't work for all of them. But that
5 will give you a path integrated in 3-D shots of emissions.

6 And yes, it is expensive.

7 Those are the three ways. We are zeroing in
8 right now on just discussing the backfitting approach.

9 As a meteorologist, I do feel the backfitting
10 approach has attractive features about it.

11 The most attractive feature is that it's
12 emphasizing the location where the bystander is. I mean,
13 why are we doing this work? Well, it's for the
14 bystanders.

15 We want to estimate exposures to bystanders by
16 placing the monitor around the field we are measuring
17 where the bystanders are.

18 As Dr. Reiss appropriately pointed out
19 yesterday, when you do your fitting of the emission rates
20 for those locations, then you use those emissions data to
21 estimate more broadly variability and uncertainty in

1 concentrations around the field, it's matched, it's
2 "calibrated."

3 We have to be careful using that term. It's
4 usually a no-no in the air quality business, to calibrate
5 models. Well, in this case, it's not doing a traditional
6 calibration of the model. It's doing emission -- it's
7 doing source testing, more or less.

8 And it is allowed in source testing. But the
9 point is as long as you are consistent between how you do
10 your fitting and how you do your actual exposure
11 assessment, many sins are forgiven along the way because
12 it's consistent.

13 If you have underestimated your emission rate,
14 you have compensated. Let me reverse that. If you have
15 underestimated your model dispersion term, it would
16 compensate on the flux term.

17 Want to do it as accurately as you can. Yes,
18 you have to be careful in extrapolating. That point came
19 up yesterday. It is important. But the issue is it is a
20 more forgiving system that way if there is bias in part
21 of your system. It should be self correcting.

1 Let's start this process at the top. Conducting
2 the field studies. There are approximately 20 field
3 studies for metam-sodium, off-gassing bystander release.

4 We are emphasizing one, I'm discussing a couple
5 of them here. We have 11 fairly recent studies over the
6 last, say, five or six years that are most representative
7 of current practice. But it's about 20 studies done all
8 told.

9 The purpose of the field studies really is to
10 get an observed. When we do these studies, typically, we
11 place the monitors in three rings, starting at about 150
12 meters, then going out to 300, 500 or 700 meters,
13 depending upon the study and available land.

14 We are trying to get multiple rings to cover
15 different -- dispersion characteristics. And in the
16 latest studies, tried to have 15 monitoring sites to get
17 the ends up there. That's the basis to get observed data.

18 We need to do normalized modeling. And all
19 that means is modeling assuming one microgram per square
20 meter per second. What would be the effect of modeling
21 that normalized value? And then those normalized values

1 are used in conjunction with observed data to do the best
2 fit procedure. And we'll get into how that's done in a
3 little bit.

4 We are using the standard error from that
5 procedure, from the least squares analysis, to compute the
6 distribution of the means for every period.

7 So in other words, period one, we use four hour
8 averaging in the field studies. First four hours, we fit
9 the data. Do a least squares analysis. Compute the
10 standard error from the residuals and then we'll use that
11 for within that block of time to estimate what range of
12 emissions would be possible. What is the distribution
13 from the 2.5 to the 97.5 percentile -- percent confidence
14 level of the mean.

15 Go on to the next four hour block. We will use
16 that fit for that period of time and so forth.

17 So in a typical study, we have 24 four hour
18 periods, which is four days. Every one of those periods
19 will have its own emission fit, its own distribution.
20 That distribution is sampled to account for both the
21 variability and the uncertainty in the emission term.

1 Now, I have got to confess here. Sometimes you
2 do these periods and the meteorology doesn't cooperate.
3 What do you do when you are doing a period and the wind
4 decides to stop blowing for most of the hours? Or it
5 blows very erratically?

6 As all you know, when you get light winds, they
7 stop going in straight lines and start to move like they
8 call it the "drunken walk." They kind of meander back and
9 forth. They don't go in straight lines any longer.

10 Gaussian modeling does like straight lines much
11 better than curvy lines. And you can get situations like
12 was shown in the last couple days where, yes, sometimes
13 the measurement realizes -- this is MITC. There the model
14 has no idea.

15 Was something wrong? No, there's nothing wrong.

16 There is limitation of Gaussian modeling. The wind was
17 blowing towards that monitor off and on. Maybe it some
18 real high concentrations. But over the hourly average
19 meteorological processing, it didn't hit that site.

20 So you get a zero in the model. The measure
21 value might be 100 micrograms. My point is you can get

1 times where it doesn't work. You'll get a fit that you
2 just can't use. It's not right. Your standard error is
3 huge. Has no regression.

4 So there are several ways to fill those missing
5 data gaps. One way is interpolation, which can be used.

6 We have most recently tried the approach of
7 using time series fit. And my thought on that was it
8 allows us to use the full data set to make that judgment.

9 You can weight the importance as you see fit. But it may
10 do a better job of filling those data points. I really
11 would appreciate your comments later on that point as well
12 when we get to that -- or now if you want.

13 In the end, what we do is through this
14 procedure we have followed, we are using a cubic fit to
15 come up with four parameters to describe each of those
16 distributions.

17 So we'll have a data file in FEMS. Each
18 application sealing method is going to have 24 records.
19 It will have four numbers per record. That's defining the
20 emission distribution for each of those periods, each of
21 those four hour periods. That's what is being sampled

1 when we create the ISC input files.

2 So again, in going through these slides, keep in
3 mind that, again, the red is the part that's really the
4 new and different part.

5 I think there is many ways to fit emissions
6 data. I will admit that I have learned a lot about how to
7 do this from DPR.

8 We had a different approach in the beginning, a
9 different approach in a number of things. They have
10 tended to be right. We are trying to come to the final
11 resolution of our methods, and I think we are very close
12 to doing so.

13 We are using least squares fit. It doesn't
14 have an intercept in it. If it needs an intercept, we can
15 certainly do it that way. I'll describe why I did it the
16 way I did it in a little bit.

17 But we are trying to in this way have a one
18 parameter fit. Our expectation was it would reduce the
19 standard error, simpler fit.

20 And then we are isolating our uncertainty in the
21 slope term. We are saying we know the measured data

1 fairly well. It's GLP studies. There's a lot of
2 controls. It is pretty good data sets.

3 And the model as long as you don't constrain it
4 to be exactly right in space and time, that's pretty good
5 too. So our uncertainties in the slope term -- that's
6 basically what we are doing.

7 I want to give you a sense of what we are basing
8 this work on. When you want the break, please let me
9 know.

10 DR. HEERINGA: I wonder since this may be a
11 logical point to break, I think there may be several
12 questions, if we could, just to catch up at this point.
13 There is a lot of material. I want to make sure that the
14 panel members have an opportunity to ask specific
15 questions while we are still fresh in the context.

16 Dr. Portier had a question, I believe.

17 DR. PORTIER: Ken Portier. I wanted some
18 clarification on the random start again. I guess I'm a
19 little confused.

20 You have 200 years of hourly data in a data set
21 and you are going to pick a slot to start the process.

1 And that slot point may be 2 o'clock in the morning on
2 July 16th, 1965. Right?

3 That's where you let out your clutch. And then
4 you are going to run that for four days of hourly data or
5 four hourly blocks. Right?

6 MR. SULLIVAN: Correct.

7 DR. PORTIER: So that's your climate set that
8 you are going to input into the model. How does this get
9 matched with emissions again? The application might be at
10 8 o'clock in the morning, the initiation of application.
11 How does that get matched with the 8 o'clock data that's
12 four hours later into the sequence?

13 MR. SULLIVAN: What it is doing is the inputs
14 that go into the ISC model -- when we run FEMS, and, yes,
15 it takes a long time to run FEMS -- because it is running
16 200 years of (inaudible) data to account for the
17 variability.

18 When it is doing that, it is continuously
19 running that cycle of 24 four hour periods, the emission
20 cycle. The only difference from year to year is the
21 perturbation of the emission distributions and the met

1 distributions.

2 So it is running it through that cycle. And it
3 is feeding all that data into TOXST, those records.

4 What TOXST is doing is saying -- when it
5 triggers a start to an application, it is tagging where to
6 go in that file in the ISC file to begin its sequence.

7 ISC knows the duration of the batch is 96 hours.

8 So it is going to read 96 hours -- 96 records. It is
9 going to read along there. Like I say, let's say it
10 started in the hour 2 of period 15. It is going to start
11 there.

12 And the meteorology and the emissions data are
13 matched to that point in time. It will finish period 15.
14 It will do 16 through 24.

15 Then it's now in the cycle back of period one
16 again. It will go one, two -- up to period 15, hour one.

17 What it's doing -- TOXST works with hourly averages.
18 Hourly data has to go into it.

19 It is generating the hourly outputs that can be
20 averaged later in TOXST. It has taken -- all those hours
21 go into the distributions and numbers are being assessed

1 and crunched.

2 The order -- it won't put them in the same
3 order. But the important thing was to maintain the
4 integrity and the match between the meteorology and the
5 emissions.

6 Otherwise, I would have had a mismatch. And it
7 would have totally biased my results.

8 DR. HEERINGA: Dr. Majewski.

9 DR. MAJEWSKI: Excuse me. I'm a little confused
10 here. You are running 200 years simulation with five
11 years of met data?

12 MR. SULLIVAN: We are taking five years of met
13 data. It could be 50 -- if you want to go to the next
14 level, you could put 10 different sites in if you wanted
15 to, five years each.

16 But for this example, we are using one five year
17 data set, which, generally, in terms of the American
18 Meteorological Society and EPA, is considered a reasonable
19 period of time for deterministic modeling, for example.

20 We are taking that five year data set and we're
21 processing through that data set 200 times, each time

1 going through each hour and perturbing the meteorological
2 -- like I say, the wind was 2.4 meters per second.

3 We are using the expert elicitation distribution
4 for wind speed that I referenced in my report to define
5 the distribution, but the uncertainty is around that
6 value.

7 You are going to sample it. Maybe instead of
8 getting 2.4, you are going to get 2.6 or 1.9, whatever it
9 is. It is perturbing that to get 200 simulated years of
10 data.

11 At the same time, it is simulating -- it's doing
12 the perturbation of emissions to match up with that. It
13 is perturbing that uncertainty as well.

14 So when you are done, you have 200 years of
15 hourly emission files and 200 years of meteorological data
16 that is processed through the ISC model.

17 DR. MAJEWSKI: So the emissions is for four
18 days, and you are resimulating those four days every day
19 with a restart of the emission or is it one -- is it one
20 application or -- every four days or is it one application
21 and you are running it for 200 years?

1 MR. SULLIVAN: Let's say you are doing a 1,000
2 year simulation to get some distributions established.

3 Statistically, you are going to have 1,000
4 starts. It might be two in one year. It might be none in
5 another. But over the course of 1,000 years, you should
6 have -- approximately 1,000 applications would be done.

7 Each one of those applications are evaluated one
8 by one. Runs for each of the 96 hours that are assessed
9 in that period of time. It is tracking by receptor what
10 the distributions look like when you do that.

11 So it is iteratively adding to those receptor
12 points. Concentration hits between different threshold
13 points and tracking that over the 1,000 years.

14 When it is done, it will show you over the 1,000
15 years what the distribution would be for each receptor
16 point that's evaluated in TOXST.

17 We take that information and through
18 interpolation we'll work with buffer zones, for example.
19 But TOXST is structured at the receptor level to do that
20 kind of tracking.

21 But it is -- in that sense, if you did 1,000

1 years, you would be 1,000 times four -- 4,000 days would
2 be off-gassing in that period of time.

3 We contend that if a person lived next to that
4 field for 1,000 years, that's what they would see. Many
5 times it is zero or natural background, which, for this
6 case, is approximately zero.

7 Whenever we put monitors in the field and do the
8 studies, the upward monitors are below detection limit
9 consistently. And the detection is .2 micrograms per
10 cubic meter.

11 So that is really what it does and how it
12 processes it. Did that answer your question?

13 DR. MAJEWSKI: I'll have to ponder it some more,
14 but yes.

15 DR. HEERINGA: Let me clarify. When you talk
16 about 200 years, I think that's apparent, but just to be
17 sure, it is 200 synthetic years of data. You are not
18 trying to predict Bakersfield weather in 2204.

19 MR. SULLIVAN: No, we are not good at that. No.

20 DR. HEERINGA: So we have 200 synthetic years
21 of data.

1 The one question I had about the entry point in
2 your randomization, is that being driven by the mechanics
3 of the TOXST summarization?

4 You really would like to simulate an early
5 morning application, right, and with a four day runout on
6 that early morning application. So you wrap around on the
7 days to pick that up?

8 MR. SULLIVAN: We wrap around so that when we
9 get to what really is the start of the application, maybe
10 it is 7 o'clock in the morning on day one, we have the
11 correct emissions and meteorology time of the day in
12 there. It is going around a carousel, basically.

13 DR. HEERINGA: And you are doing that because
14 TOXST -- that's the way it works, because it is designed
15 to have sort of time random emissions.

16 MR. SULLIVAN: Yes.

17 MR. HEERINGA: So you are forcing it to simulate
18 an early morning application that runs for four days. And
19 if you happen to enter TOXST at 3 in the morning, you
20 sort of wrap time back for 24 hours and then move ahead.

21 MR. SULLIVAN: Correct. Our GLP field database

1 is morning applications. Generally, an hour after sunrise
2 or just about at sunrise. So we did try to maintain that
3 integrity, that match-up on that basis.

4 DR. HEERINGA: Thank you.

5 Dr. Yates.

6 DR. YATES: I actually have two questions now
7 because the last one has sort of -- I thought I understood
8 what was going on and now I'm not sure.

9 In using the data, I guess, first you put it
10 through ISCST. Then TOXST does the starting part. I
11 think the TOXST part I might understand. But now -- this
12 is kind of related to what Mike was saying.

13 How is this random data used in the ISCST model?

14 MR. SULLIVAN: What we are doing in ISC is we
15 are inputting one year at a time the perturbed emissions
16 meteorological data that's going into the ISC model.

17 ISC is being run -- in that sense, once that
18 goes in there, it is a deterministic, just running each of
19 those hours through.

20 DR. YATES: So you are running like the met data
21 for one year and -- because this is kind of I think what

1 Mike was saying, is that you have four days of emissions.

2 And if you are running day by day, you can't start -- you
3 can't have a flux study and then the next day start
4 another one, the next day start another one.

5 That was where I started getting confused.

6 MR. SULLIVAN: What ISC is doing -- the way the
7 emissions sequence through ISC, say it is the first day, 7
8 o'clock in the morning the first day it has the start of
9 the emission period.

10 Like for period one, start of the emission
11 period. That's 7 in the morning that day.

12 It will go for four days. Then when it gets to
13 the 7 a.m. on day five of the met data set, it is back to
14 where it started from. It is going to repeat that cycle
15 again.

16 All that information is fed into TOXST one hour
17 at a time. It will process the hourly output from ISC, is
18 what actually goes into the TOXST model. But it is based
19 upon that sequence.

20 DR. YATES: So basically, the ISC is used to run
21 four days and four days and four days and four days?

1 MR. SULLIVAN: Correct.

2 DR. YATES: That's making sense, then. Now I
3 have my real question.

4 You were saying that -- this gets back to trying
5 to determine the slope and looking at the indirect method.
6 When you do your field studies, you have a meteorological
7 station on site. Is that correct?

8 MR. SULLIVAN: That's correct.

9 DR. YATES: With high frequency wind speed and
10 wind direction?

11 MR. SULLIVAN: We sample the winds' exposures
12 heights at two meters and 10 meters. We have vertical
13 anemometers to get Sigma W, and collect the standard, soil
14 radiation, temperature and so forth.

15 DR. YATES: So you would have the data to be
16 able to see if -- I mean, if you look at hourly averages,
17 you get a mean and you get a variance. But you have the
18 data to be able to look and see if there is any of this
19 meandering going on.

20 So you could actually go back and decompose the
21 period that's causing you problems if you have wind speed

1 -- I mean, wind direction all over the place, look at the
2 amount of time proportional in each direction and take the
3 total, you know, mass that's being emitted during that
4 period and partition it.

5 It would be complicated. If you have a lot of
6 these, it could be very time consuming. But you could
7 actually go back and make it so that the model would fit
8 maybe better, the data that's outside of this period
9 average wind direction.

10 MR. SULLIVAN: That's a good point. We have
11 done that. Basically, our data is stored minute by
12 minute. So we have 60 wind directions, wind speeds per
13 hour. And yes, we have gone back and done that during
14 these odd ball periods of time.

15 And sure enough, you do see the wind is blowing
16 towards that monitor, occasionally, and I guess at high
17 concentration some of the time. Then it is totally the
18 other direction.

19 There are ways of addressing that. Whether or
20 not it is appropriate, that's getting into, you know, puff
21 modeling and so forth or just interpolate it or use a time

1 series, that's open for discussion. It could be done
2 either way.

3 But it does get a lot more complicated when we
4 try to follow those puffs around.

5 DR. HEERINGA: Mr. Sullivan, what I would like
6 to do at this point and for other panel members, I would
7 like to take our break and come back with a few additional
8 questions.

9 I know that Dr. Hanna and Dr. Spicer have
10 questions. But for the sake of the audience and the rest
11 of us, let's be back here at 45 minutes after 10 or
12 quarter of 11, which is on my watch about 14 minutes from
13 now.

14 And we will continue with a few additional
15 questions.

16 (Thereupon, a brief recess was taken.)

17 DR. HEERINGA: Welcome back to the second half
18 of our morning first day on FIFRA SAP meeting on the FEMS
19 model. And we are going to continue with a short series
20 of questions from panel members to Mr. Sullivan about some
21 aspect of the presentation prior to our break.

1 I have maintained an order, an original order.
2 Dr. Hanna.

3 DR. HANNA: My question is again back to the
4 ISCST model runs. If you repeat a certain experiment, are
5 you going to get the same numbers again based on this --
6 between the 200 year application and the specific five --
7 from the five year?

8 You will get the same numbers?

9 MR. SULLIVAN: You get approximately the same
10 number. It is random. So what we have recommended is a
11 certain number of years to simulate. We have tried to
12 maintain it as being random.

13 DR. HANNA: So the purpose, really, is to create
14 this database to account for the uncertainty.

15 MR. SULLIVAN: Right. I should clarify one
16 question that came up during the break. Is that we do
17 process the meteorological data five years at a time to
18 create those 200 years, sets.

19 Every time we do that, it is -- there is a
20 random start to that period. We will start the
21 applications at any particular day. Any day in the data

1 set could be a start. It is not always the same day being
2 started.

3 That point I did want to clarify. The question
4 was asked earlier.

5 DR. HEERINGA: Dr. Spicer, I believe you had a
6 question.

7 DR. SPICER: Yes. Well, I believe you said that
8 for 1,000 years worth of data you would have 1,000
9 releases. So basically, you are talking about one release
10 per year. Is that correct?

11 MR. SULLIVAN: Statistically, one release per
12 year. There is no restriction. It is going to do the
13 starting application in accordance to the user supplied
14 probability.

15 If it is being done for a seasonal analysis,
16 what is the probability for starting an application in
17 that season. If it as an annual, do the annual
18 probability.

19 It is going to sample on that basis. TOXST
20 statistically will turn 1,000 times approximately over
21 1,000 years.

1 DR. SPICER: At another point in time you said
2 that this ran in four day loops so that you had a release
3 every four days.

4 MR. SULLIVAN: Not a release in a sense of
5 TOXST. ISC is preparing data that TOXST can use. Unless
6 it engages with TOXST, that data is never used.

7 So it's over 1,000 years when you use every
8 single day, of course. But it is going through that ISC
9 data set to get the data it needs to do the distributions.

10 And there is 200 years of data you can pull
11 from.

12 DR. SPICER: You actually do have simulations
13 every four days. But then you may only sample some of
14 those simulations in the output?

15 MR. SULLIVAN: Depending upon how many simulated
16 years you have. If you simulated 10,000 years, for
17 example, you are pretty confident you have sampled every
18 single day as a start or whatever.

19 But no, that's just a function of how many years
20 you simulate.

21 DR. SPICER: But then you do allow for the

1 capability of having a seasonable variation. For example,
2 you wouldn't have a start time on Christmas day, for
3 example?

4 MR. SULLIVAN: Well, it could start on Christmas
5 day. But let's say we did a seasonal run and we put in
6 seasonal meteorological data. We put in data for winter,
7 for example, and created our distributions on that basis.

8 It is going to be sampling from those days. It
9 will not consider if it is a weekend holiday. It won't
10 consider if there is rain or snow.

11 But what it is saying is that data set
12 represents the variability and uncertainty in the
13 meteorological data for that location or that region. And
14 it will not have restrictions on it on that basis, no.

15 DR. HEERINGA: I believe Dr. Portier has a
16 question.

17 DR. PORTIER: This is just a follow up
18 clarification. You pick this 96 hours with a random
19 starting point. And if it starts at 2 o'clock in the
20 morning, the real emissions are going to start at 8
21 o'clock.

1 And when you get to the end of that sequence,
2 you are going to take that beginning time and put that at
3 the end and you are going to figure out emissions for that
4 at the end. Right?

5 MR. SULLIVAN: Correct.

6 DR. PORTIER: So he has 96 hours. It is always
7 in a sense the high emission is always going start when
8 the process started. He just takes that header part and
9 puts it at the tail.

10 MR. SULLIVAN: Correct.

11 DR. PORTIER: And that creates the 96 hours.

12 Now, my understanding is, then, you have that 96
13 hour block and you are creating 1,000 of those that are
14 going to go through to generate 1,000 emission levels for
15 each of your sites, each of your locations that you are
16 trying to figure out what the emissions would be.

17 And that's what the ISC model does for you. It
18 runs it 1,000 times.

19 MR. SULLIVAN: What it's doing, it has 200 base
20 years. So that four day cycle is imbedded in each of
21 those years. It is pulling from those four day cycles

1 into TOXST.

2 And like you said, if it started in the second
3 day, it is pulling -- at that point has emissions data in
4 that modeling for the second day. And then it will go to
5 the third day, and get real low concentrations on the
6 fourth day.

7 In this example, your high concentrations
8 happen on the fourth day, when it wrapped around. But the
9 main point is it is capturing improper diurnal matching,
10 all 96 periods.

11 Not in the same order that they came in. But in
12 the same -- it captures every one of them.

13 DR. PORTIER: So I'm getting a better picture
14 now of what is happening. Suppose in the first draw you
15 pick July 2nd and then somewhere around the 500 draw you
16 picked -- July 2nd at 2 o'clock in the morning and then
17 the 500 draw you pick July 3rd at 9 o'clock in the
18 morning.

19 There is an overlap between those 96 hour, two
20 96 hour periods. How does that get -- and supposedly they
21 are the same climate data from the same year.

1 How does that get put into that sequence that
2 goes into ISC?

3 MR. SULLIVAN: We do each of the application
4 simulations independently. So there would be two separate
5 independent simulations done at different times different
6 years.

7 They wouldn't be exactly the same, because the
8 emissions and the meteorology would be perturbed and it
9 would be different. It would track each of those
10 separately.

11 It would then put that information into the
12 receptor output array in TOXST. TOXST is tracking how
13 often concentrations are above various concentration
14 levels at each receptor.

15 And each of those examples you gave would be
16 tracked and computed separately and tracked by receptor.

17 DR. HEERINGA: Dr. Winegar.

18 DR. WINEGAR: Yes, you have used the word
19 perturbed a number of times in describing what you do. And
20 that brings back bad memories for me of perturbation
21 theory in quantum mechanics. So I think I may have a

1 black hole in my mind.

2 But what I'm understanding is that basically,
3 when you say perturbed, you are talking about the process
4 where you are setting limits within the Monte Carlo
5 simulation process. And then from that you gather -- you
6 resample, essentially, to create a new distribution.

7 Is that what I'm understanding correctly?

8 MR. SULLIVAN: Yes. Sorry for the bad memories.

9 Yes, that's what I was talking about. We are sampling
10 with the 95th percentile, 95th percent confidence of the
11 mean.

12 So from 2.5 to 97.5 percent confidence level is
13 what we are sampling from.

14 DR. WINEGAR: So from the 200 year set of
15 simulated data you draw distributions, and then you come
16 up with a new resample distribution that ends up giving
17 your error bounds.

18 MR. SULLIVAN: That's correct. I mean, the
19 meteorological data that is collected, of course,
20 sequentially, is maintained in that same manner.

21 But the sampling of the uncertainty will adjust

1 the numbers up or down each one of those years. So every
2 year will be somewhat different than the other year.

3 DR. WINEGAR: True.

4 DR. HEERINGA: Thank you very much. I think we
5 are beginning to get a better understanding of the
6 mechanics of the model processing. We will make
7 absolutely sure that we are clear on this before we end
8 our presentation and discussion today. But I think it is
9 a good chance for you to continue here.

10 MR. SULLIVAN: I believe this is where we ended
11 at the break.

12 The field studies that have been collected, just
13 as an overview, I'm to going describe the most recent 11
14 field studies that I have been involved with with the task
15 force.

16 There has been others before that. But the most
17 recent ones that have been done. And this isn't including
18 pilot scale studies that have also been done during the
19 last five years.

20 I'm terming this by application method. For
21 shank injection, there have been four studies done over

1 the past five or six years.

2 Initially, a study was done in 1999 based upon
3 using standard sealing technology. And all that really
4 means -- standard for California. Shank injection, you
5 use the tractor, you inject into the soil.

6 And as the tractor goes by, there is another
7 crew connecting the main line and turning on the
8 sprinklers and water sealant is being used for the sealing
9 methodology.

10 We came back the following year after doing
11 laboratory research comparing compaction, VIF tarp,
12 intermittent sealing, and found in these tests that
13 actually intermittent sealing as applied there was about
14 equivalent to VIF tarp for MITC.

15 And so after conducting pilots to confirm that,
16 went in the field in 2000 and did the first intermittent
17 sealing full GLP study.

18 I'll show the results later as for all of these.

19 Then we repeated that study also in Kern County during a
20 hot time. It was early September. Not quite as hot as
21 here, but quite hot, and repeated it and got similar

1 results.

2 And then last summer, did a shank injection
3 with compaction instead of using water as the sealing
4 methodology.

5 In terms of chemigation. Again, in 1999 we did
6 what we call the reference to the baseline study. Came
7 back the year after the one I just described, the first
8 intermittent sealing, and did the second one in August of
9 2001.

10 And that was to test how well intermittent
11 sealing would work for chemigation. That test also is
12 repeated in the USDA study in September 2002 concurrent
13 with the shank injection testing I just described.

14 In terms of drip studies, two studies were done
15 in '97. One tarped, one untarped. And through USDA
16 sponsorship, we have conducted two studies over the last
17 year or so. One in the sands of Florida and one in
18 Salinas, California.

19 As Jeff Dawson pointed out earlier, the sequence
20 does go -- the least off-gassing method tends to be the
21 drip. No big surprise there.

1 Shank injection. Intermittent -- it depends --
2 when you get into the shank injection in the chemigation,
3 it depends how you seal the field. If they are both
4 sealed the same way, shank would tend to often have lower
5 concentrations.

6 If intermittently sealed, for example, yes, the
7 shank injection does provide less off-gassing.

8 But that's just an indication of some of the
9 more recent studies. And there are older studies going
10 back to '93, '94, '95. Some of the cultural practices
11 have changed, but that data is still useful in the
12 historical sense.

13 I will proceed. Some of these points were
14 already made. I do want to give you a sense of what these
15 field studies look like.

16 Our case study again is chemigation/
17 intermittent sealing, the study done on August 2001. Here
18 we have a 20 acre, 15 to 20 acre size field.

19 There are 15 monitoring sites established around
20 this field ranging from about 150 meters in this case out
21 to, I think, around 500 or 600 meters away.

1 The meteorological monitoring station was very
2 close to the field. These locations are all very, very
3 flat. Essentially, no tree cover obstructions in the
4 area.

5 And these studies also -- and this study and in
6 some of the little bit more recent studies we have soil
7 component as well and efficacy component at the same time.

8 But in terms of this study, we are gathering 15
9 sets of four hour average concentrations. 24 of those
10 periods over a four day period of time during the hot
11 summertime in the clay loam sands of Kern County. That's
12 the basic layout that was followed for those studies, the
13 more recent studies.

14 We started by trying to be clever and tried to
15 predict wind flow. Being meteorologists, we thought we
16 could do that pretty good. It didn't always work out the
17 way we planned. We don't do that anymore.

18 We do ring the field. We will tend to emphasize
19 the expected down wind for that location. But we have
20 changed the basic philosophy on that to be more uniform
21 around the compass. It does work better.

1 Just to show what these places look like.
2 Usually, these fields don't have much around them. This is
3 a pretty typical looking kind of a situation. This is the
4 one I just showed you.

5 As you can see -- these are fields.
6 Occasionally, you will have farm houses nearby. This is
7 more or less typically what we see. Very flat. Rural
8 modeling is definitely appropriate.

9 And just to clarify on that, it came up
10 yesterday, EPA has very specific criteria for urban versus
11 rural switch. And even if there are homes nearby or some
12 residential nearby, that would not trigger urban.

13 Generally, if you have driveways, you have
14 lawns, even in suburban Philadelphia, suburban D.C., you
15 will still be modeling it as rural, generally, almost
16 always. So I just want to clarify that particular point.

17 Now, what are the optimal conditions? What have
18 we learned from doing these studies? I did want to share
19 this information with you. The minimum eight sites
20 uniformly spaced, uniformly covering the compass is what
21 we do recommend.

1 We often cover the north, south, east and west
2 sites. And then we cover the corners, a little bit
3 further away. If you want to cover the close in ones at
4 100 meters, maybe it will be 200 or 300 meters at the
5 diagonals. But at least eight sites going around the
6 field as a minimum.

7 I'll show the designs that we used in the last
8 couple studies. My preference -- after looking at the
9 results further, my preference is to use a combination of
10 eight fixed and four, what I will call, opportunistic
11 sites.

12 I don't mean just going around in the middle of
13 the monitoring study trying to put new sites up. But
14 typically, when we go in the field, we always take out a
15 lot more monitors than we need. Things break down. Get
16 rained on. Farmers forget that we have stuff out there
17 and they turn on the pumps and irrigate our pumps, which
18 doesn't to them any good. We always have extra pumps.

19 The point is if you can set them up
20 strategically around the field, you could collect
21 supplemental data, the function of wind flow, to increase

1 your ends (ph) in your fitting procedure. And I believe
2 substantially improve the fitting process.

3 I am just throwing that out as an aside, but
4 that is something I think that would help a lot. You can
5 get by with 12 or 13 sites that way and probably capture
6 more detectable data.

7 Not changing sites. (inaudible) which ones to
8 turn on would be a function of conditions. It is just a
9 concept.

10 We tend to go -- in the smaller scale studies,
11 it may go as close as 25 meters. But for a major scale
12 commercial application, generally, the closest ring is at
13 150 meters.

14 Just want to avoid any potential near field
15 effects. Especially during convective conditions.

16 What time periods cause problems in fitting
17 emissions data. Well, the biggest problem is -- first of
18 all, we can't apply unless it meets the constraints of the
19 label.

20 But keeping that to the one side -- the best
21 conditions are those that do not produce real steady

1 winds.

2 You have a period that has 10 mile an hour winds
3 out of the west pretty steadily for the whole period.
4 That's probably going to be a bad period. It is going to
5 hit maybe two or three monitoring sites.

6 A better period is one where there is more
7 spread of the plume, there is more sites involved in the
8 fit. That's one reason why we have more recently have
9 gone to the concept of six hours instead of four hour
10 sampling, to try to expand the number of hits you get at
11 the monitoring sites.

12 The other issue, obviously, if precipitation
13 occurs after the application is done, the second day,
14 third day, it will kill the pumps. We have had terrible
15 luck. Those are the kind of conditions we do try to
16 avoid.

17 Before discussing the actual nuances of fitting
18 emissions data, I want to start by saying that when you
19 look across the distribution of the full data sets, for
20 example, this test case data set, all 24 periods, and if
21 you do a fit using the DPR procedure, you do the fit using

1 the procedure we have in this methodology here, you get a
2 very similar answer in the big picture.

3 If you are looking at the best fit expected
4 values, the differences aren't large.

5 The issue is when you want to go into
6 distributions and you want to input distributions into the
7 probabilistic assessment, there may be advantages to
8 alternative procedures.

9 I'll present one here today. Maybe it is not
10 optimal, maybe it is. But there is two things we need to
11 accomplish together to come up with one method that will
12 work for everyone.

13 That's basically to have a method that will work
14 for all different chemicals, we'll do a good job on the
15 best fits, what is the expected value. But also do a good
16 job on the distributions. The important point is we are
17 sampling from the 2.5 to 97.5 percent confidence of the
18 mean.

19 If we have a distribution that's based on
20 coefficients of variations that are higher than .3 or .4,
21 we are going to hit some negative numbers if it's done as

1 a normal fit.

2 That was a concern that we have. The other
3 concern we have -- if that occurs, we know it can get
4 negative emission rates.

5 What if the upper tail is skewed, what if it is
6 skewed high? What if it is logarithmically skewed? We
7 would underestimate the actual upper side, upper tail.

8 So we have developed an approach that does use
9 transformation prior to computing the least squares fit.
10 In our judgment, it does produce comparable results over
11 the distribution of emission rates that are computed.

12 It won't match period by period for sure, there
13 will be differences, but in the big picture it will give
14 you similar numbers.

15 Our position also is that it may not be
16 mathematically the best approach. Maybe there are better
17 ones, which we would like to know about and do.

18 But in terms of conserving mass from what we can
19 tell in doing these comparisons, it does appear to be
20 doing a reasonably good job on that. The mass losses do
21 seem reasonable.

1 So I will show you the data. But the reason
2 that we went to that approach was our concern that with
3 the way the CVs are with these kind of data sets, you are
4 either going to have to truncate the bottom or have
5 negative numbers. If you do that, the concern was in the
6 upper tail.

7 We are definitely trying not to understate the
8 upper tail distribution. The approach that we will follow
9 in my judgment is more conservative than a normal fit on
10 the upper tail numbers. The actual vested numbers are
11 very similar.

12 This is the test case that we are talking about
13 the whole time. And I know it is hard to see back there,
14 but in blue -- the measured concentrations are shown along
15 the Y axis.

16 Taking the normalized modeling times emission
17 rates, the different methods are along the X axis. And in
18 green, I'm showing the DPR numbers. These are my
19 calculations.

20 And Terri and I will need to get together at
21 some point and see if hers match what I did. This is

1 applying the methodology that DPR uses.

2 And in blue is showing the FEMS fit. I am
3 showing the best fit lines through this scatter plots. And
4 my point is across the big picture, big scheme of things,
5 they are pretty similar.

6 In terms of looking at the distributions,
7 comparing the distributions both ways, if you work your
8 way up 30th, 40th, 50th, 60 up to 90th percentiles, they
9 are similar. There are some differences, yes, but they
10 are quite similar in that context. In my judgement,
11 that's a good thing.

12 There are more than one ways to do many things
13 in science. This could be one of them. But in that
14 sense, the numbers do seem somewhat similar.

15 It is again at the distribution level that the
16 differences probably become more pronounced.

17 Now, I'm just putting some quotes down of what
18 led me to go this route. I'm not a statistician. Some of
19 you are, and I will defer to your judgment on these
20 things. But I'm looking at these quotes.

21 I'll just read one. It is widely used in

1 environmental analysis to represent positively valued data
2 exhibiting positive skewness. Examples include
3 concentrations of chemigation -- chemicals, actually, in
4 the environment. That's from an OPP guidance document.

5 The second one from Hahn and Shapiro, a
6 statistical test, variables for which values concentrated
7 close to some physical boundary are quite common. In such
8 cases, the normal distribution or any symmetrical
9 distribution is inadequate.

10 We have noticed that the residuals of the least
11 squares are more normally distributed when you do the
12 logarithmic interpolation of measured model prior to doing
13 the least squares.

14 The fundamental data, the concentrations in the
15 air or water, the fundamental data is known that they are
16 log normal. You can look at most any data set that you
17 see in the environments and you look at it and you plot it
18 out as being normal versus lognormal. Concentration tends
19 to be lognormally distributed.

20 Wayne Ott from EPA -- used to be from EPA, did a
21 very good paper on that explaining why that is.

1 And also in terms of the meteorological theory,
2 many of the things that we work with in turbulence scaling
3 are logarithmically distributed near the surface,
4 temperature fluxes, wind flux, and so forth.

5 So the underlying concentrations, the measured
6 and modeled concentrations in my judgment they are
7 lognormal.

8 I will provide some examples of why. This is
9 all based upon the measured data set. I'm using that as
10 an example, that if we look at probability plots both
11 ways, look at the Shapiro-Wilkes test for normality, and
12 then evaluate the CVs of these measured data sets.

13 First of all, if you do probability plots, this
14 is a pretty typical one, if we do a standard plot without
15 doing log transform, it doesn't approximate a straight
16 line all that well.

17 It does better as a natural log. Any one you
18 look at looks fairly similar to this one here. If you run
19 the Shapiro-Wilkes test for normality, you find that the
20 normal fit -- this is the first six periods of the case
21 study example.

1 All six were below -- all six were significantly
2 different than a normal fit, where when you do the log
3 transformation there is one that is close. The other five
4 are above the criteria, which support that fit.

5 And lastly, the coefficient variation in the
6 measured data for sure is large. If you look at the
7 coefficient of variation in that sense, you see why it
8 ends up being log normal. It doesn't mean that the fit
9 has to be log normal.

10 I am just making a point that the underlying
11 data, modeled and measured concentrations that derive that
12 fit equation, are log normal.

13 We'll start with the issue about whether or not
14 an intercept is needed. Again, how ever this works out is
15 what we'll do. There will be a consensus method. It will
16 be in or out. We'll all be glad when this is decided, but
17 there are at least two ways this can be done.

18 Either you put the intercept in or you don't.
19 You will see in our approach we have gone for the simpler
20 fit. We have gone for the one parameter fit with just
21 looking at the slope.

1 One of the reasons we have done that is based
2 upon the measured data for this example. MITC in the
3 environment, every study that we have done, if you look at
4 the upwind data, it is nondetectable at a .2 microgram per
5 cubic meter detection limit.

6 So at least for this example chemical, if the
7 concentrations are that low, our feeling is they are using
8 the simpler one parameter fit is preferable because adding
9 the second parameter would increase the standard error
10 without providing us major gain.

11 And you statisticians tell me if that is right
12 or wrong. But that was our logic of going to simpler
13 least squares fit. And we certainly can put that
14 intercept in there if that's the consensus approach.

15 How good a job does it do? Well, when you put
16 the monitors out in the field, this is typically what we
17 tend to find. In this case, our true upwind -- you see
18 these .2s capturing some of the plume in here.

19 But this is the typical pattern study after
20 study period after period. So we are pretty confident
21 that the background would justify that that treatment --

1 if background is the criteria for deciding if the
2 intercept is in or out.

3 When I compute the standard errors either way
4 without doing any kind of transform, just to compute the
5 standard error, I'm finding when I add the extra parameter
6 that it increases the standard error in my fit. My
7 confidence intervals for those slopes increase.

8 My goal is to minimize standard error. So in
9 that sense, the wind parameter fit seemed to be a
10 reasonable way to proceed.

11 The Draper and Smith reference, I think I
12 described in my report, does present an approach called
13 centering the mean. Centering the mean subtracts the mean
14 value from each of the variables.

15 So X_i minus \bar{X} . And Y_i minus \bar{Y} . That,
16 as I read that, that reference will produce the -- it
17 won't constrain the intercept to go through zero, but it
18 will approximately go through zero.

19 So for this data set, I used that approach and I
20 computed it with the centering approach versus the
21 approach used here. And I found there were some

1 differences, but by and large they were small.

2 And so in that sense, it seemed that, at least
3 for this chemical in these tests, that the intercept was
4 not a major term.

5 I'll describe how to compute the best fit
6 emission rate. Then we'll get into distribution secondly.

7 To compute the best fit emission rate, with the
8 exception of converting these measured model values into
9 logarithms, I followed an approach in the Bertha (ph) and
10 Brown statistical reference that's in the background
11 documents.

12 And that procedure we have provided a constant
13 value to make the fit more well behaved near zero. And
14 doing the fit, based on the simple least squares
15 regression slope analysis. It is a fairly simple
16 procedure.

17 So at this point here, we are computing -- what
18 that will provide to you will be the Y being the measured
19 value is equal to the B, which is the slope component in
20 log space times the X bar, the X and log space.

21 That is the basic procedure. So each of the Xs

1 is your modeled values, the log of the model values. That
2 multiplied times the B computed in log space would equal
3 the observed data and log space. That's the basic
4 procedure.

5 The standard error is computed according to the
6 same reference material and computed based upon the
7 residual values.

8 And that standard error then can be used to
9 estimate the average in nonlog space. So when we are back
10 transforming the best fit emission rate right here, the
11 ones we would actually use with the modeled values, we are
12 using this procedure here to do the back transformation.

13 Again, this is for the best fit. Not for the
14 percentiles. For the best fit.

15 When we do this fitting procedure, we generally
16 start anywhere from 10 to 15 monitoring sites, 10 to 15
17 pairs of data points. And we have these criteria in our
18 system.

19 You need at least three pairs to try to quantify
20 with this method. Three being a pretty small number. The
21 coefficient of slope needs to be significant. Standard

1 error less than 1.5.

2 Those are the criteria that we use to do these
3 fits. If those criteria were not met, we would default
4 that period. Either fit it by interpolation or by a time
5 series.

6 In this test case I'm showing you here, they
7 all met this criteria. There was no filling required.

8 Now, to show the best fit values, I'll also show
9 the before and after. The values shown here in red are
10 showing the reference study, the one done back in 1999
11 with standard sealing methodology for shank injection.

12 The four days shown here, the nighttime period
13 is shown where it is dark. Daytime is showing where it is
14 light. 24 periods in the X axis. Each a four hour
15 length. And the emission rate is on the Y axis.

16 During the particular shank injection studies
17 done without the extra sealing, we get higher numbers.
18 This peak here is conservative, we feel. It probably
19 could be reassessed somewhat.

20 But the main point is we got substantially
21 higher emission rates prior using the extra sealing

1 procedure. The one shown in blue is showing intermittent
2 sealing for shank injection and showing that these are the
3 bit fit numbers right down the line.

4 We're showing after even making adjustments,
5 this conservative value, we are showing that in this '99
6 study of shank injection that we lost about 84 percent of
7 the potential MITC.

8 In the study with the extra sealing
9 methodologies down here we lost approximately 20 percent
10 of the available MITC. It made a substantial difference
11 in the amount that is retained in the soil.

12 But the main point I'm making here is this is
13 showing the best fit emission rates from that procedure.
14 This is a defaulted period right here that could be
15 refined.

16 This is showing you basically -- we're getting
17 numbers that do show the diurnal trends. As an aside, the
18 advantage of this intermittent sealing procedure is your
19 peaks are now in the daytime and it is damped off. It is
20 much lower at night.

21 That's an example of the best fit numbers for

1 shank injection.

2 This is for chemigation. Again, in red it is
3 shown the reference study, the 1999 study, with regular
4 sealing methodology. We have high emissions in the first
5 evening. The cycles then drop off after that.

6 These are the best fit numbers shown in blue for
7 the test case study, the chemigation/intermittent sealing
8 study. And again, we are showing a nice diurnal pattern
9 to this fit. We are showing that the peaks were shifted
10 to the daytime.

11 At nighttime it is dropped. (inaudible). And
12 this procedure does do a lot of good in terms of exposure
13 reduction. But this is what the actual best fits look
14 like.

15 Again, the ones in blue are the best fits for
16 the case study we are discussing here today.

17 That's used in the log transform procedure just
18 described. If I had shown -- I could have shown this
19 graph using the DPR procedure. There would be some
20 differences along there, along the way. If I did a
21 distributional display instead, they would look quite

1 similar.

2 A different scale here. Going from zero to 60
3 micrograms per square meter per second. I just wanted to
4 make the point that on these intermittent sealing studies
5 we have replicated those again. They were studied in
6 September of 2002.

7 Intermittent water sealing again produced low
8 emission rates, especially during the nighttime periods.
9 But again, much lower emission rates than in the reference
10 studies.

11 I'm showing -- I do want to again emphasize
12 there is a very large difference between doing these
13 emission fitting procedures for Kern County in the
14 summertime compared to almost anywhere else where it is
15 cooler temperatures, substantially cooler temperatures.

16 But if you look at this information shown here,
17 I'm showing four studies that were done in cooler
18 conditions. Van den Berg was done in the fall in the
19 Netherlands. Saeed was done in Wisconsin. I believe in
20 the fall. And Schepel also was done during cooler
21 temperatures.

1 These maximum concentrations of 7 to 12
2 micrograms per cubic meter were for samplers quite close
3 to the field, anywhere from zero to 50 meters.

4 If you compare those kind of numbers with the
5 maximum concentrations in the studies I have just shown,
6 which range from 205 to 1,000 micrograms per cubic meter,
7 at 150 meters away we do conclude that temperature is a
8 very important parameter for volatilization of MITC.

9 So when we do say that the emission fitting
10 procedures done for these studies are conservative, it is
11 relative to the other studies that are available in cooler
12 conditions. And that does appear to be the case.

13 DR. HEERINGA: I wonder, Mr. Sullivan, whether
14 it would be a good chance at this point, again, I don't
15 want to interrupt the flow of your presentation, but to
16 entertain a few questions on what you have presented so
17 far.

18 There is a lot of material. I know when we get
19 into this that I don't want people to lose track.

20 I have Dr. Yates first.

21 DR. YATES: Actually, with the slide you are

1 talking about right here, I agree that seasonal effects,
2 that temperature does play a part in this. But I think
3 that it might be a little bit misleading to only talk
4 about heat or temperature as causing these kind of drastic
5 changes.

6 Because I know in the Netherlands they do have
7 cooler conditions, but their soils are quite different and
8 they also have a lot more organic matter. I remember
9 visiting there once and talking with Van den Berg.

10 And they were telling me that their soils had
11 actually developed the capacity to actively degrade MITC
12 when it was applied to soil. So there are other factors
13 here.

14 There is -- reactivity in the soil could explain
15 very much of the difference here as well as temperature.

16 MR. SULLIVAN: That's a good point. There are
17 many variables in there.

18 The degradation, if there is enhanced
19 degradation, usually that takes place after the initial
20 sampling periods would be done, though.

21 In other words, you take your first samples. You

1 would expect to get high concentrations at that point in
2 time, and then it could taper off more rapidly if there is
3 enhanced degradation going on.

4 But these heavy soils issue is certainly a
5 significant issue too. The Lost Hills study has shown,
6 which was the shank injection with intermittent sealing,
7 that was in a clay loam.

8 So that was in a heavier texture soil. I think
9 soil texture is an issue. What we are seeing though,
10 looking across the board, temperature appears to be a more
11 sensitive parameter than soil texture.

12 But I'm sure soil texture is a significant
13 factor as well as organic content could be too.

14 DR. HEERINGA: Dr. Portier first, then Dr. Wang,
15 then Dr. Spicer.

16 DR. PORTIER: When you had the slide that said
17 reasons fit through zero, you mentioned any intercept
18 greater than .1 micrograms per cubic meter is a
19 mathematical artifact. Did you choose the .1? Because
20 didn't I hear you say something about .2 is the detection
21 limit? Is that right?

1 MR. SULLIVAN: Yes, I'm referring to half the
2 detection limit as how we characterized. In all the
3 fitting procedures we had, we treated those values as
4 .1s. Half of the detection limit is what we used.

5 DR. PORTIER: So any zero became a .1 when you
6 did the log transformation?

7 MR. SULLIVAN: Right.

8 DR. PORTIER: Then you did this .75 offset on
9 the best fit. Can you explain why did you throw in .75.

10 MR. SULLIVAN: We put in .75 based upon -- the
11 reference material that we used recommended putting a
12 constant in there between .5 and 1. We tested it without
13 the constant with .5 and 1 and found across the four field
14 studies in 96 total periods that it seemed to be of the
15 most reasonable results.

16 Without the constant, we found that the results
17 were not -- they weren't as good. It was done sort of
18 empirically, but the constant seemed to make the fit more
19 well behaved.

20 DR. PORTIER: The other thing is that the
21 calculation here, computing emissions distribution at the

1 bottom, you have the B average is E to the B plus a half
2 the standard error square.

3 That comes out of Otts' book, if I remember
4 correctly. He talks about back transforming log estimates
5 back to -- I think we need to check that.

6 Paul, I'm going to have to see if you can find
7 me a copy of that. I'm not quite sure this is right.

8 MR. SULLIVAN: I have a copy of Bertha (ph) and
9 Brown (ph) in my car that I can bring in at the break.

10 DR. PORTIER: Maybe over lunch. I would like to
11 look at that.

12 MR. SULLIVAN: I'll bring that text in.

13 DR. HEERINGA: Dr. Wang and then Dr. Spicer.

14 DR. WANG: Two questions. First to follow up on
15 the comments by Dr. Yates is that the location that you
16 ran the metam-sodium experiments in California, are those
17 soils being fumigated previously with metam-sodium? And
18 what is the history of those sites?

19 MR. SULLIVAN: Most of those fields were fields
20 that were in rotation for carrots or potatoes by Greenway
21 Farms and Both House (ph) Farms. They do fumigate those

1 fields. They were not virgin soil or anything. They had
2 been fumigated before.

3 It is fairly typical farmland in California.

4 DR. WANG: The reason to bring that up is that
5 if a field has a history, that tends to enhance the
6 degradation. So if there is no further study on the half
7 life, that may be shortened if you have a longer duration.
8 So that may help you explain that.

9 MR. SULLIVAN: That's a good point. I think
10 when Dr. Feiler is introduced, he can discuss this.
11 Because the enhanced biodegradation issue is a function of
12 the pH of the soil.

13 So it depends if you have -- I believe it is a
14 high PH soil. He will explain that. That's when there is
15 potential for enhanced biodegradation. It would be
16 helpful if Dr. Feiler could handle that one for you.

17 DR. WANG: The second question is on one of the
18 figures you showed to compare the modeled and measured
19 concentrations between the measurement -- between the FEMS
20 and DPR. And you have a linear fit. It seems the points
21 all over the place. It goes quite a ways back. Even

1 further back. Keep going back.

2 MR. SULLIVAN: Are you referring to the scatter
3 plot?

4 DR. WANG: Yes. Could you comment on the fit?
5 There is a large amount that is red to origin.

6 MR. SULLIVAN: It is just a simple best fit
7 line, regression line that I believe had an intercept on.
8 I just did a very quick display of what the best fit was
9 through the green points and the blue points shown there.

10 This is putting a straight line. Y equals MX
11 plus B in that example there. And there is a lot of
12 scatter. I expect -- we do expect in the atmosphere there
13 is a lot of differences and the methods of course have
14 their uncertainties in them.

15 My point really was that if you look across all
16 the data points and account for the scatter, that there
17 doesn't appear to be a big difference between the
18 methodology in a distributional sense.

19 There are differences period by period. There is
20 no question about that. That's the only point I was
21 trying to make.

1 DR. WANG: Because if I only look at the data
2 points, I almost can draw the line any way I want. It
3 seems to be a cloud to me.

4 MR. SULLIVAN: There is a lot of uncertainty you
5 are asking about. And that's why we have to do the
6 sampling of uncertainty. Because that's the reason.

7 We don't know these numbers as well as we wish
8 we did. I think that through improved design of networks,
9 maybe through some improved analytical methods of how to
10 do these fits we can do better.

11 I hope we can. But as the state of the art
12 right now, I guess this is what we are saying it is. And
13 if we didn't account for the uncertainty, we would
14 underestimate the upper tail of distributions. No
15 question.

16 DR. WANG: Thanks.

17 DR. HEERINGA: I think it is important to note
18 just visually looking at this graph that we have slightly
19 different scaling metrically on the numerically, but the
20 distances are compressed. You get a little bit of
21 compression right to left in this graph.

1 Dr. Spicer.

2 DR. SPICER: Go ahead and leave that slide up.
3 To what do you attribute the variation in that plot, to
4 what physical phenomena?

5 MR. SULLIVAN: The variation is -- well,
6 physical phenomena, that's a hard question. I wish I knew
7 the answer to that. This is strictly based upon the
8 differences and fitting procedures.

9 We are using the same normalized modeling, the
10 same measured data points. It is being fitted a different
11 way.

12 DR SPICER: I'm not talking about the fit. I'm
13 talking about the data. I'm not talking about the
14 straight lines. I'm talking about the comparison between
15 the measured concentrations and the modeled
16 concentrations.

17 MR. SULLIVAN: In my opinion, the reason why --
18 when you get a lot of discrepancy between the model and
19 the measured data points is two key meteorological
20 factors.

21 The most important probably is wind direction.

1 This issue about you get some flow during the hour towards
2 those monitors that the model doesn't even know about. So
3 that's one factor.

4 The other is stability. As was mentioned
5 yesterday, stability is an approximation into six discrete
6 classes. There is mischaracterized during one in
7 particular hour, the spur of the plume may be too little
8 or too much and you lose some correspondence there.

9 I think those two physical factors are the most
10 important in my judgment.

11 DR. SPICER: I guess I would also just include
12 the variability and the emission rate as far as that is
13 concerned. There is that effect as well.

14 MR. SULLIVAN: Yes. My point was it's the
15 uncertainty and emission rates, a lot of it is driven by
16 the uncertainty in the meteorological data that is being
17 used to fit, which makes the model term more uncertain.
18 That would then flow into the estimate of the slope.

19 They are kind of interrelated factors.

20 DR. SPICER: Just out of curiosity, you used,
21 seems like, a basis of one microgram per square meter

1 second. The fluxes that you get obviously depend upon
2 whether you are doing this intermittent treatment or not.

3 Have you ever considered looking at the fit
4 using a different basis instead of the one microgram per
5 cubic meter -- per square meter per second? The reason
6 why I ask that is obviously if you are doing this not with
7 a log normal transformation, then those changes are
8 definitely straightforward in the flux. They are
9 absolutely linear.

10 But because you have got this log
11 transformation, there might be some effect to the fitted
12 parameters. I'm just curious if you have investigated
13 that effect.

14 MR. SULLIVAN: We have tried different
15 normalization values. I didn't find an effect. But I
16 didn't search it for what you were saying.

17 But in the end we are doing -- the way we are
18 doing the procedure is we are taking the measured and the
19 model data, transforming each of those, computing a best
20 fit emission rate and distribution back in original units
21 again, multiplying that times the modeled values.

1 So if we had normalized to 10 instead of 1 and
2 did that procedure, would we get the same answer. I think
3 we would, but it would be useful to test that. That would
4 be something we could do.

5 DR. SPICER: This certainly doesn't seem a
6 trivial operation since you are adding this .75 and
7 several other things like that.

8 MR. SULLIVAN: That's a good point. That could
9 be done, definitely.

10 DR. HEERINGA: Dr. Winegar.

11 DR. WINEGAR: I have a question in regards to
12 the fitting process. There was an exchange yesterday
13 afternoon between a question that Dr. Barry posed in
14 regards to whether it is appropriate to fit this kind of
15 data -- whether it is appropriate to do a log transform of
16 the data.

17 And there was response by Dr. Mitchell that it
18 was not -- or Dr. Small, that is, that it was not
19 appropriate because it wasn't physical.

20 And it kind of made sense at the time, and maybe
21 I missed something in that exchange, but then I got to

1 thinking about it last night. It's like, well, we do lots
2 of things with data that really aren't "physical."

3 And now you are describing doing a log
4 transformation and doing that regression on that. So I'm
5 trying to reconcile these two views. What is the
6 appropriate way to go?

7 MR. SULLIVAN: I wish I could have spoke to Dr.
8 Small yesterday about it. Of course, I couldn't with the
9 nature of the panel here. But I don't know that he is
10 referring to specifically what I did.

11 If you were to try to do a transformation of the
12 B value, the slope values, that would certainly be
13 incorrect to do.

14 We didn't get into the procedures here. We did
15 the logarithms of the concentrations. It is pretty much
16 an accepted fact that concentrations in the air tend to be
17 log normally distributed. So that part I feel confident
18 about.

19 In doing it that way and we follow the land
20 distribution procedure, which should give you an exact
21 back transformation, our numbers seem reasonable and our

1 mass balances seem sound.

2 Our comparisons, like with other method that Dr.
3 Barry used, seems similar. Not the same, but it doesn't
4 show a mass balance problem in there.

5 So I guess I would like to have that reviewed
6 again. In terms of what we are doing here with this
7 approach, if it's not right or not optimal, we want to
8 definitely change it.

9 But I think that that wasn't discussed, the
10 full procedures that we have been talking about here. My
11 question would be if we aren't going to do a log
12 transformation, how, then, are we going to account for the
13 negative numbers?

14 How are we going to handle coefficients of
15 variation .5, .8, if you look at all these studies, all of
16 them? What are we going to do then? There has to be
17 another procedure, then.

18 Because to do the fits of distributions with CVs
19 that take into negative land that may underestimate the
20 peak exposures, peak emissions you really care about,
21 that's an issue.

1 Our goal here is as I said at the beginning was
2 to do what we could to be accurate. Are we not trying to
3 get the lowest or the highest?

4 We are trying to be accurate where we can with
5 these emission rates and with the modeling of the
6 concentration frequencies. That's why we went the way we
7 did. Because our concern was, if you don't do the log
8 transformation, you will underestimate the upper tail.

9 If it's not going below zero and it happens to
10 be skewed right, well, then, if you have a risk assessor
11 that's concerned about a rare event such as when over a 20
12 year period would it be above the NOEL without a 100 fold
13 factor, if you misjudge the upper tail, you give them the
14 wrong answer.

15 I'm not a statistician. This may not be the
16 best way, but I feel confident from knowing the data the
17 way I do that some method is needed to avoid two things,
18 negative numbers and understating the upper tail.

19 Whatever the best way to do that is we should go
20 to that. I'm proposing this for consideration. And any
21 statistician or anyone who knows of a better way to do it

1 we would like to do it that way. But that's why we went
2 the way we did with those two concerns.

3 DR. HEERINGA: Just a comment. I think we will
4 make a point to make sure at least that the mathematics of
5 the statements such as Dr. Small's statement yesterday
6 are, in fact, confirmed and then there may be other model
7 fitting issues which will be more to the discretion of
8 the individual analyst.

9 But I'm sure we'll have plenty discussion of
10 that in the course of this two day session.

11 Dr. Seiber and then Dr. Yates.

12 DR. SEIBER: Could you go forward to the one
13 that says USDA shank injection that was a plot of emission
14 rate versus period?

15 Could have been on any of those curves. But my
16 question is more in how the data was acquired. In your
17 field experiments, you showed that you had samplers at
18 several locations, including several downwind.

19 Were emission rates back calculated from many or
20 all of those downwind samplers and then averaged to get
21 the emission rate per period or am I misunderstanding what

1 this curve --

2 MR. SULLIVAN: No. Each one of these dots is
3 showing a best fit least squared regression, best fit
4 emission rate, and it is based upon all the data.

5 DR. SEIBER: So many samplers would have been
6 processed.

7 MR. SULLIVAN: Right. In this case I think
8 there were 16 in the field, doing two studies, eight
9 samplers for a GLP study. The last two had 15 samplers.
10 But it is based upon the number that are there and the
11 best fit is done on that basis.

12 When the measured data show a nondetect, they
13 are treated as .1s. When the modeling is showing zero to
14 be consistent, we treat those as .1s also when we do that
15 fit.

16 DR. SEIBER: Then when you integrate under
17 either of those curves, you get the total amount emitted
18 over that period of time.

19 MR. SULLIVAN: Correct.

20 DR. SEIBER: That's how you would do your mass
21 balance.

1 MR. SULLIVAN: That is correct.

2 DR. SEIBER: Typically, for those two examples,
3 what, approximately, would they integrate out to in terms
4 of mass?

5 DR. SEIBER: I didn't integrate these out, but I
6 could tell you for the comparable studies. The blue line
7 is representing chemigation intermittent sealing in the
8 follow-up study.

9 Chemigation intermittent sealing released about
10 23 percent over four days. And the red line, which
11 represents the shank injection intermittent sealing,
12 released 20 percent over four days. And these are
13 probably similar. Not the same. I didn't compute it. We
14 could.

15 DR. SEIBER: And my last point relative to that
16 is, of course, we are assuming the back calculation method
17 is accurate. Did you have any of those experiments where
18 you had an alternate flux measurement tool, either an
19 aerodynamic method or some other so you could compare and
20 see if we are talking 100 percent accuracy or 50 percent
21 or how does it compare with some other method.

1 MR. SULLIVAN: We didn't. That would be a
2 research effort that certainly could be done and has been
3 done for some of the other chemicals, and Dr. Yates has
4 done some of that too.

5 We haven't done that. I guess the only point I
6 would want to make in fairness to all the methods, there
7 isn't like one benchmark, one standard way, as we all
8 know.

9 And there are uncertainties and limitations to
10 various methods. So you could put down a flux chamber.
11 You could put down an aerodynamic method sampler and could
12 put down a ring of ambient samplers too.

13 Which one is right. Hopefully, they will both
14 be the same. But what we don't know, which one is better.
15 That's pretty hard to know.

16 Actually, Dr. Yates and I collaborated in trying
17 to put together a research plan for funding last year to
18 bring together the aerodynamic method, I think flux was in
19 there too, the ambient method, back calculating and remote
20 sensing.

21 Because you can do remote sensing for MITC.

1 Haven't gotten that in yet. But that would bring all
2 three together in the same plane. But we did not do it in
3 these studies here.

4 DR. SEIBER: Thank you.

5 DR. HEERINGA: Dr. Yates has a question.

6 DR. YATES: Actually, a couple. First, just a
7 point of clarification for myself.

8 In any of the data that you are showing for
9 flux, are there any chamber measurements that are being
10 shown today?

11 MR. SULLIVAN: No. These are all based upon
12 back fitting from ambient data set.

13 DR. YATES: The other thing. I guess with
14 respect to this slide, I have looked at a lot of flux
15 distributions with time. And I know that this sort of
16 behavior happens.

17 But it always troubles me a little bit when you
18 have two low points and one data point that is real high
19 and nothing in between. Because an artifact in the data
20 of whether it is meteorological, whether it is from data
21 handling or whatever, the interpretation of that blue

1 line, say, if the fourth point was somewhere else would be
2 quite different.

3 So there is a lot of things that when we look at
4 that, you know, there is a lot of things that people are
5 probably thinking, wow, at the fourth period there is a
6 really high flux.

7 But that's only supported by one data point,
8 really. And it's really to me -- it is just a comment.
9 You only have the data that you have. So you have to use
10 it to the best you can. But that's maybe one of the
11 reasons why I think higher frequency sampling would be
12 advantageous.

13 Because if you had something up on the sides, it
14 would kind of give you a feel. For example, if you look
15 at the red one, you have two points close together with a
16 little -- I suspect that if you had high frequency
17 sampling, you would see a very high flux there in the
18 middle.

19 Which also brings up my second question. I
20 think you said that it is hard to estimate the flux with
21 the indirect approach when you have strong steady winds

1 that are high velocity because of few points. The
2 uncertainty in that is how high is that just in kind of a
3 qualitative sense? Is that very high uncertainty or --

4 MR. SULLIVAN: It can be very high. Let's say
5 you use a traditional type approach. You place your
6 monitors around the compass. You may be basing your
7 fitting procedure based upon three data points. Maybe two
8 data points will be quantifiable data.

9 That's one of the reasons why I mentioned I
10 think a refinement to this procedure would be to have
11 additional staked pumps in the field that you could
12 increase your ends even if that occurred because that
13 would increase the ends.

14 You would always have at least five or six where
15 in the traditional approach you end up with two or three.

16 And that's hard. Then you can get these uncertainties.
17 And you are right, this number maybe should have been up
18 here. Maybe that number should have been down there.

19 But that's also the reason why I'm saying I
20 think the distribution approach is really critical because
21 we can't say in sequence we get these numbers all right.

1 Our expectation is if you look at the distribution, it
2 probably is much better.

3 DR. YATES: But getting back to the strong wind
4 and high uncertainty, though, you know, in terms of risk
5 assessment, that is the kind of rare event that is of
6 concern.

7 If your flux input to the model is not very good
8 when the winds are blowing really hard in one direction --
9 of course I guess in a way when it comes to human
10 exposure, that would be a time when there would be a lot
11 of mixing too.

12 But the rare events is something that you want
13 to capture in the distribution. I'm not sure -- there are
14 times when you can see that there is limitations in that.

15 MR. SULLIVAN: I agree. That is why we -- the
16 extra samplers would handle that. But in terms of the
17 dispersion modeling aspects of it, if we have these strong
18 steady winds -- let's say the wind is blowing 10 miles an
19 hour, that means there is two things we're diluting.

20 Number one, the wind speed dilution term.
21 Compared to a factor of one mile an hour, that's tenfold

1 reduction. And then we would not have stability. We will
2 have neutral conditions, both which would act to reduce
3 the impacts.

4 So where your persistence would go up, the
5 actual concentrations would go down. So those usually
6 would not be your limiting factors, usually. Could be.
7 But I don't disagree with your point, Scott.

8 It is a situation where if you don't have enough
9 coverage there, you could miss something.

10 DR. HEERINGA: Dr. Baker, then I think we will
11 move on with the presentation.

12 DR. BAKER: Again, just a point of clarification
13 for myself. I believe your discussion with Dr. Spicer was
14 on the -- when you compared the log transformed
15 environmental concentrations to the log transformed model
16 predicted concentrations, you are doing it for a reference
17 flux level, which is a unit flux level, I believe.

18 And the suggestion was to try another flux level
19 rather than that -- as your reference rather than the unit
20 flux?

21 MR. SULLIVAN: Yes.

1 DR. BAKER: One possibility was, say, a single
2 iteration where you get a first case nominal reference
3 flux and then you put that in and into the model, generate
4 a new model predicted concentration field, and then
5 compare that to your environmental concentration field.
6 Is that correct?

7 MR. SULLIVAN: It is a good point. I think
8 that's something we can do and will do just to assess how
9 different is it.

10 DR. BAKER: To some extent and I think that
11 would help address the question that was raised yesterday
12 by Dr. Small.

13 DR. HEERINGA: Dr. Baker, just an encouragement
14 to make sure that we restate that as part of one of our
15 formal responses to the questions too. It sounds like a
16 good recommendation.

17 MR. SULLIVAN: We'll make a note of that and
18 look into that.

19 DR. HEERINGA: At this point I guess I would
20 like to let Mr. Sullivan continue with his presentation.
21 He has actually anticipated a lunch break. And I think

1 we will stick pretty close to where he winds up.

2 The lunch break will probably go a little bit
3 past the noon hour. My anticipation is maybe 12:20 or
4 12:30.

5 MR. SULLIVAN: I better not go too slow or I
6 will make a lot of enemies here at lunch time. So if it
7 does get to be 12:30, please let me know, we will be done.

8 I'm just going into the procedure that was used
9 to do the actual distributions and I will bring in the
10 texts as was requested so that those will be available to
11 any members who want to see the text that this is based
12 upon.

13 But in terms of what you will see here, in doing
14 the back calculation for a percent, different percent
15 confidence levels of the mean, the same two terms that
16 were present in the previous, in the best fit are still
17 there.

18 The mean in log space of the slope plus .5
19 times the standard error square, that's still there. But
20 now there is a third term that's based upon the Land 1972
21 reference, exact fit to a back transformed confidence

1 level.

2 And that reference does shows this procedure.
3 You can compute the value for any confidence level that
4 you want. What we have done is computed for the levels
5 shown here from the 2.5 level to 97.5 level.

6 We have filled in a couple points with
7 logarithmic interpolation, which is recommended by Dr.
8 Land. And have done the final fit based upon a cubic fit
9 to the data as he also recommends as a preferred fitting
10 procedure.

11 So the new thing here is the last term, the H
12 value from the Land tables is now included to improve the
13 fit for percent, different percent confidence levels. And
14 this cubic function is solved. It is fit for each of the
15 24 periods where we have emission fits for each
16 application method.

17 The R squared values in this fit are about
18 .99. We don't usually see that in air quality work. But
19 interpolating these tables, that works quite well.

20 So if you looked at the FEMS model and looked at
21 a current 2001.Dat file, for example, you would find 24

1 records in that file, four parameters per record. That's
2 the best fit numbers.

3 Just to show you an example of the cubic fit.
4 Again, percent confidence of the mean is what this really
5 is, from 2.5 to 97.5 fit with a cubic fit.

6 And the model, when it creates the 200 base
7 years, is pulling from these distributions each time, when
8 it creates the emission files that go into ISC.

9 This is what the actual file -- it is nothing to
10 write home about. The file looks like this. Just the
11 coefficients. It is a concise way of representing the
12 distributions, is really what it is.

13 The time series fit, what I have done here is
14 just showed an example of it. I'm showing the four GLP
15 studies. I'm not just using the test case study here, but
16 I just want to give you a feeling for how this works.

17 We are doing this in SPSS which requires four
18 complete cycles. We fortunately have four complete
19 cycles. We have six data points per day.

20 And so we are showing in green is the fitted
21 time series, and in blue, which is the actual data that we

1 have. And in the distributional sense, it does, I think,
2 a fairly good job. It's not perfect, but it provides at
3 least an alternative way to fill in missing data along the
4 way.

5 To run this procedure, however, you do have to
6 interpolate initially. So if I was missing period 5, I
7 would have to interpolate for period 5. Then do my time
8 series. I would recommend taking the result of the time
9 series, then improve that estimate.

10 This is just a concept I'm putting up for
11 discussion. I'm not certain this is better than just
12 doing interpolation, but it seems like it may be better.

13 This is showing an example for the test case for
14 this today's discussion.

15 This is showing a similar analysis for the
16 shank injection intermittent sealing approach. Again, in
17 green here it is showing the fitted procedure, time series
18 fit. And in blue, it's showing the actual data points.
19 It does miss some along the way. I'm showing this from
20 best to worst.

21 One advantage of this approach also it does

1 provide at least one way to forecast. Because a question
2 will come up, especially with four day data sets, well,
3 what happens on day 10.

4 We don't really know what happens on day 10.
5 We're extrapolating out 50 percent past it. If it kept to
6 a similar trend, you could argue maybe it won't go below
7 zero. That probably doesn't go below zero.

8 But it would likely approach minimal levels,
9 diminimus levels sometime in day 5. That's what these
10 time series suggest.

11 This is going to the shank injection standard
12 sealing fit. And the worst one, which really doesn't work
13 very well -- this is probably mislabeled. Well, no --

14 This is showing the fit, which is not a good
15 fit, for the shank injection standard sealing. The other
16 one was the chemigation. That is mislabeled.

17 My point is in every case the time series didn't
18 help. In this case it was not a very good fit. I'll show
19 you the R squared values for each one of them.

20 The R squared values of the time series versus
21 the original data was fairly good for the intermittent

1 sealing studies. These are the studies where we did
2 listen to DPR in the design concept.

3 We did do better. Better coverage. This study
4 here -- actually the one that we had back (inaudible) --
5 was chemigation standard sealing. We had a number of
6 periods where the wind didn't cooperate.

7 The design wasn't quite there. And did result
8 in the fact that the correspondence was quite poor.

9 I'm just presenting this as something that I
10 would appreciate your input on regarding is time series a
11 way to improve filling data gaps or is it preferable just
12 to interpolate. I'm putting it up for discussion.

13 Just showing a couple examples of the
14 distribution plots. You will notice what this is showing
15 again is the 24 periods, day and night is being shown as I
16 described before. The emission rates in this plot are
17 from 10 to 80 micrograms per square meter per second.

18 The best fit line is shown in brown on here. You
19 will notice a lot of uncertainty during the first
20 afternoon in and morning. That's my fault that that
21 occurred.

1 I was at the meteorological station. I was
2 trying to look at the sensors. And I pressed a button on
3 the computer to bring it up. And the data logger died.
4 It killed the data logger for some mysterious reason.

5 So the first few periods in here had to be
6 modeled off-site as represented data as we could, but not
7 on-site data. The uncertainty was clearly higher.

8 We tended to see more uncertainty in the
9 afternoons in general, though, leaving that one aside. And
10 one of the reasons I believe for that is twofold.

11 One, Gaussian models do not work so great during
12 convective periods. There is more up drafts and down
13 drafts. There are near field effects. That's a fact. So
14 there will be more uncertainty on that basis.

15 We have three distances we are fitting from and
16 you are going to get some scatter from that.

17 The other factor is in these studies, Kern
18 County, summertime, during the afternoons, that sandy soil
19 heats up. The winds pick up, become steadier, and we get
20 less monitors being hit. So the standard errors increase.

21 I'm hypothesizing those two factors of likely

1 the reason why. So that's for shank injection
2 intermittent sealing.

3 This is chemigation intermittent sealing. Again,
4 I'm showing from the 2.5 percent confidence up to the 97.5
5 percent confidence distributions that we pull from here.

6 You can see that with the log fit back
7 transforming that it is very much skewed to the upper
8 tail. My position is unless we are confident that we can
9 fit this without some kind of transformation, whatever it
10 be, that we have to be careful at not understating the
11 upper tail.

12 But it does show a strong diurnal pattern to it.
13 The amplitudes are decreasing each day and approach
14 levels that would not cause a buffer zone issue by the
15 fourth day.

16 This is my last slide before lunch. So that's
17 good. I will finish here by almost noon time.

18 I was at the Air Management Conference this
19 June. They had a session there on probabilistic air
20 modeling. And actually, Dr. Hanna, I think, was there, I
21 think spoke at that session.

1 And Dr. Steve Hanna was there, a meteorologist,
2 who has seen quite a bit of work on probabilistic modeling
3 procedures. And he asked the question, somebody presented
4 some data, didn't have a lot of data points. He said how
5 do you know when you have enough data to do these kind of
6 fits? Do you have enough data for what you are trying to
7 do?

8 That's a good question. It is a hard question.

9 And I think that the best answer is in the Cullen and
10 Frey reference, which I can pull the quote from. I
11 paraphrased it here. But what Cullen and Frey have
12 basically said, the most important factor is that your
13 data be representative of what you are trying to address.

14 In this case, we are trying to address what the
15 measured concentrations are around that field. We're
16 trying to capture the plume. To do that, we need to have
17 a decent design to network. We have to have high quality
18 measurements.

19 Not a lot of scatter in those numbers because
20 you represent a typical field, which I will contend that
21 they do.

1 The Cullen and Frey reference went on to say
2 that as long as you have good representative data, you
3 should focus on characterizing the uncertainty in the
4 random sampling error.

5 It may be large. Three data points, going to be
6 quite large. As you have more, it will become less. But
7 the issue here by addressing the uncertainty, whether it
8 be three data points or 15 fitting from, we are
9 acknowledging when you have a few data points we don't
10 know it as well.

11 We believe the data are representative. We just
12 don't have a lot of them. That's, I think, the key
13 advantage of bringing the probabilistic component in for
14 emissions. We can give the risk assessor a more honest
15 assessment, acknowledging what we know and don't know, and
16 make sure these distributions we produce properly
17 characterize that upper tail, which is of greatest
18 interest to them.

19 With that, I will close for the morning session.

20 DR. HEERINGA: Thank you very much, actually
21 very timely. I would like just to make sure we keep

1 context for questions here that if there are any questions
2 from the panel before lunch, anything that you would like
3 to ask Mr. Sullivan at this point?

4 Before we adjourn for our noon hour break, I
5 want to make sure to do a little check here. I indicated
6 and the agenda indicates one hour for lunch. As we learned
7 yesterday, with our local sampling of culinary
8 institutions, some of them have a log normal distribution
9 on serving times.

10 The panel, and I guess I will look to others
11 too, is one hour adequate for lunch?

12 THE PANEL: Yes.

13 DR. HEERINGA: Tell you what. We'll give you an
14 hour and five minutes.

15 MR. DAWSON: Why don't we say hour and 15
16 minutes?

17 DR. HEERINGA: And hour and 15 minutes. I was
18 going to give you an hour and 10, but an hour and 15
19 sounds good. We will plan to reconvene here at 1:20.
20 Thank you, everyone.

21 (Thereupon, a luncheon recess was taken.)

1 MR. HEERINGA: Welcome back to the afternoon
2 session of the first day of our two day SAP meeting on the
3 Fumigant Bystander Exposure Model Review focusing on the
4 FEMS model with metam-sodium as a case study.

5 We are going to be continuing at this point with
6 a presentation of Mr. Sullivan on the FEMS model. We have
7 a few questions I think possibly from the panel. I know
8 that Dr. Portier has one.

9 Ken, if you would like to ask that at this
10 point, feel free.

11 DR. PORTIER: You brought up the issue of doing
12 this time series, smoothing to fill out the gaps. And I
13 mean, I'm surprised it worked as well as you show it,
14 because these series are not -- don't normally have the
15 assumptions that time series type models have, because you
16 have got that -- you have periodicity, but you have a
17 decay that's going on and it makes it very complicated.

18 You might want to look at something more like a
19 spline smoothing or something like that. Rather than
20 simple interpolation, you can use more points on either
21 side to interpolate rather than trying to fit the whole

1 time series, try to fit a smaller part of the time series.

2 I don't think you get much you are going to get
3 much mileage out of trying to predict that whole time
4 series just to predict what is happening on the end.

5 MR. SULLIVAN: I think a spline would give a
6 better fit for those gaps.

7 DR. PORTIER: For the gaps.

8 MR. SULLIVAN: Thank you.

9 DR. HEERINGA: Dr. Shokes.

10 DR. SHOKES: I have a question for you. I'm not
11 a statistician, but I don't fully understand this 200 year
12 thing, and then the five year data, how that fits together
13 and exactly why you do that.

14 Are you talking about 200 iterations or
15 something? Exactly what -- 200 years of what?

16 MR. SULLIVAN: Basically, what we are trying to
17 represent in this analysis are two things, variability in
18 the atmosphere and uncertainty. We start -- in this case,
19 this example, I'm using a five year hour by hour
20 meteorological data set.

21 For example, this data set is from Fresno,

1 California. That shows what happened over that of five
2 year period of time.

3 Our position is or EPA's position is a five year
4 data set does a pretty good job of characterizing what
5 you could expect to see for five years at least for
6 deterministic modeling.

7 In this case here, FEMS provides a risk assessor
8 with the option of looking at a very high point along the
9 distribution curve.

10 A point such that you may not see that met
11 condition happen every five years or every 25, 50 years.
12 So what we have done is we have taken that five year or if
13 we want to put 10 data sets together it could be 50 years.

14 We expanded that to 200. We have done that by
15 going through that sequential meteorological distribution.

16 In our case, we have gone through it 40 times. Each hour
17 we are acknowledging the fact that, although we have a
18 measured wind speed, a measured wind direction and so
19 forth, there is uncertainty in that measurement.

20 How well does that measurement represent the
21 trajectory we are modeling? And so what we are doing is

1 we are sampling from the uncertainty. We are sampling
2 around the 95th percentile confidence of that mean value.
3 It could be higher. It could be lower.

4 And by doing that, we are getting an expanded
5 version of what could happen over a long period of record,
6 which really is done in the situation where you are
7 looking for a longer recurrence interval event.

8 It may be that you have wind directions aligned
9 every 40 years. You have six hours in a row with very
10 steady winds with pretty poor dispersion. It will capture
11 that sort of thing.

12 That's why we put together -- we start with
13 five. We simulate what we expect to see over a longer
14 period of time by sampling from the uncertainty
15 distribution.

16 Those distributions were established by expert
17 elicitation surveys as published -- it was done by
18 Stephen Hanna formerly from George Mason University in the
19 area here.

20 Did that answer your question?

21 DR. SHOKES: I think so.

1 DR. HEERINGA: Dr. Wang.

2 DR. WANG: I hope this is a fairly quick
3 question.

4 You have shown several figures that illustrate
5 the distribution of different percentiles for the fluxes
6 over time.

7 And it appears there is a dependence of the, you
8 may say, the variability over the mean. And I wonder if
9 you use the same or somewhat of a constant coefficient or
10 variance? Because if you --

11 MR. SULLIVAN: We did not. We computed those
12 distributions one period at a time by computing the
13 standard error based upon our residuals.

14 So it is based upon the residuals from each
15 fitting period. I mean, we are taking a look at -- if you
16 take the emission rate we have calculated, multiply that
17 times the modeled values, compare that to the measured
18 values, those residuals will define the standard error.

19 We're using the standard error to create the
20 rest of the distribution. We are having the reference
21 text, the key pages photocopied. You will be given a copy

1 of it -- to address the issue about how that procedure
2 goes back and calculates the expected value and the
3 distribution. That should be available, I guess, sometime
4 this afternoon.

5 DR. WANG: The reason that it makes me wonder is
6 that the actual measurements we have done in the past you
7 are going to see large variations even when the mean is
8 low.

9 And that's quite different from what the
10 predictions has shown from these figures you have
11 presented.

12 MR. SULLIVAN: The coefficients of variations in
13 the measured data were high. The coefficients of
14 variation in the fitted, the sloped term, often were in
15 the range of point .2 to .6, 2.2 to 2.5.

16 For some of the studies that had poorer
17 correspondence it could be higher. But the issue becomes
18 more complex. Once it starts crossing that .3 line with
19 the fitting procedure, then we are approaching negative
20 land on the emission rates. That's where it becomes
21 problematic.

1 DR. HEERINGA: Dr. Bartlett.

2 DR. BARTLETT: I just would like to ask a
3 general question about the approach which is to use, from
4 what I understand, a sample standard error, basically
5 deriving your variance from a single study whereas the
6 approach that I'm more used to seeing is that you have a
7 wide variety of measurements and studies and you have your
8 understanding of variance of emissions from 10 studies.

9 And then you could from then -- from something
10 like that, you can construct a probability distribution.
11 Whereas in this case, it seems like you are taking one
12 particular field study and constructing a probability
13 distribution being derived basically by the variance of
14 one sample, one field sample to some extent.

15 MR. SULLIVAN: Correct.

16 DR. BARTLETT: So that seems -- maybe you can
17 make it clear to me why you are taking that approach or
18 you are not trying to.

19 I understand you said that Bakersfield is an
20 extreme case. But maybe you could make it clear to me why
21 you are not trying to do four or five more studies to

1 develop probability variance.

2 MR. SULLIVAN: We are taking the position, which
3 I believe is defensible, that Kern County in the
4 summertime is indication of upper end emission rates
5 including the distributions.

6 Of course, more studies could be done. And the
7 same procedure I'm describing here could be done for
8 additional studies that are the same type, chemigation,
9 for example. Intermittent sealing could do multiples and
10 samples through multiple studies if that was necessary.

11 But the approach here is to treat each
12 monitoring period, these four hour periods, as an event
13 that we want to characterize the best fit emission rate as
14 well as the distribution for that point in time.

15 And the references being copied has a section
16 that does deal with that situation how do you go about
17 computing standard error for a least squares fit slope.

18 It is basically taking the emission rate you
19 calculated, multiplying it times the model values, one by
20 one, summing that experimental error variance term itself.

21 If you divide that by your end term (inaudible),

1 you are getting experimental error variance. When you
2 divide that by the summation of all your XI terms, your
3 model terms, you are isolating out the slope term. That's
4 what we are doing.

5 We are computing the standard experimental error
6 variance first, then dividing by the summation of the
7 model values, the X term, to decouple the X times the
8 intercept value.

9 And we could have those pages copied too if that
10 would be helpful.

11 DR. BARTLETT: That wasn't the issue I was
12 responding to. I will wait until we have gone further. I
13 think things will get clearer as we go on.

14 DR. HEERINGA: At this point we would like to
15 continue with the presentation. We'll have time again for
16 questions during our discussion.

17 MR. SULLIVAN: We will continue on. We are
18 talking about the meteorological monitoring. We will talk
19 a little bit more about the modeling issues, then we'll
20 turn it over to your questions.

21 When we do these studies, a lot of emphasis is

1 placed on acquiring representative meteorological data.

2 It is very important to the overall program to have sound
3 met data.

4 As mentioned a little bit earlier, we do sample
5 at two levels in our GLP studies. When we're doing
6 smaller scale pilot studies, experimental studies, we will
7 often use one level, which may be three meters.

8 But in these studies that I'm talking about
9 today, primarily, especially that case study, this is
10 showing the two meter level, but there also are samplers
11 at the top of that mass at 10 meters.

12 We collect wind data at both levels. Collect
13 temperature data, soil radiation data as well.

14 On our GLP studies, we have added the vertical
15 component of the wind, sigma W. That was put in there for
16 some day when AERMOD becomes the model of choice. We
17 would have a way of using our sigma theta sigma W data to
18 more directly characterize the turbulence and the
19 dispersion characteristics.

20 So that data is available for that purpose for
21 the future. These studies are, these four studies, GLP

1 studies, do have very tight criteria required for
2 calibration of the equipment, maintaining of logs and so
3 forth. The data is of high quality.

4 Now, we have talked all morning about the
5 emission distributions and how those were calculated and
6 so forth. The meteorological parameters, the distribution
7 for those is quite simple.

8 It was based, as I mentioned earlier, based upon
9 expert elicitation. It probably is the only way to do
10 this at this point in time.

11 Dr. Steve Hanna talked to probably 20 experts in
12 the field of meteorology and got a consensus to what was
13 the best type of distribution and how would you best
14 characterize the 95th percentile of the mean.

15 And the assumptions are that the wind speed is
16 log normally distributed, that uncertainty. And it is
17 normal distribution for stability and wind direction.

18 On our work we have put stability into the
19 model. We aren't recommending that be used at this time.

20 It is a place saver for AERMOD.

21 The problem is stability is six discrete

1 classes. Once you get to F stability, which is the
2 condition of concern primarily, you can't go lower than F
3 stability in ISC model.

4 There is a step function that stops right there.
5 You can only get less stable.

6 Now, in a typical night, there are interludes
7 where it does get less stable. That has been well
8 documented. There is overturn in the atmosphere. That
9 happens.

10 But not as often perhaps as this would suggest
11 it happens. So we have put some numbers in there, but
12 our recommendation is not to consider uncertainty in that
13 term for that reason. It is a place saver for the future.

14 We do typically use wind direction and wind
15 speed based upon the Hanna survey to come up with our best
16 estimate of the uncertainty and those two key terms to the
17 model.

18 Now, there has been discussion about stability.

19 It was brought up yesterday by Dr. Spicer, Interesting
20 comment. Could you take the sigma Y and sigma Z terms in
21 ISC and put some uncertainty around those numbers.

1 They are very important because that determines
2 how wide and how much vertically the plume spreads. It is
3 an important term in the model.

4 That could be done. It is a question of -- it
5 is a matter of developing a special version of ISC and
6 putting the uncertainty term into those values.

7 It would be interesting to do. In the future
8 that could be done through the inputs to AERMOD.

9 Monin-Obhukov's scaling theory would allow the
10 estimation of those terms. That could be put in and then
11 you would have a continuous set of functions that could be
12 treated in a Monte Carlo bases.

13 And sometimes at night it would get real stable.

14 But that's when you have the luxury of having a
15 continuous distribution, which we don't have right now.

16 This is in our background document. This is
17 just showing the results from the experts survey. And
18 what it really is it is showing the range in expected
19 wind, the wind speed range as well as the wind direction
20 range.

21 Wind direction, there are several ways that Dr.

1 Hanna has published this. The version I'm using does
2 treat the wind direction uncertainty as a function of wind
3 speed.

4 As the wind speed gets lower, the uncertainty
5 increases. If you look in the old days when we used to
6 have to look at strip charts for meteorological data, and
7 I'm dating myself now, most current meteorologists never
8 have seen one of these things, it shows that very, very
9 clearly with light winds the tracers will meander back and
10 forth, where during stronger winds, it is nice and steady.

11 What this is doing is the kind of effect that
12 when the wind speed is low, there is a lot more
13 meandering, a lot more -- less certainty. For multiple
14 hour averaging, this point could become important.

15 In addition, when you have moderate wind speeds
16 and you are looking at a long recurrence interval, let's
17 say you were looking at how often would you exceed a NOEL,
18 that you could do a 50 year recurrence interval run.

19 Then the issue of wind persistence could become
20 important. You may not capture that in a five year data
21 set or a 50 year data set. But you could get sometimes

1 when the wind is aligned and you have multiple hours of
2 same direction, that's the reason that these terms were
3 put in the way they were, to capture that sort of thing if
4 that occurred.

5 Now, there are some special issues here that I
6 did want to address that do affect all the fumigants,
7 actually. I'll go through them one by one. This I have
8 discussed. I won't repeat. I got ahead of myself on that
9 one.

10 Actually, I have done wind direction
11 probabilities as well. I have described that
12 sufficiently.

13 Stability class changes. This one does deserve
14 some discussion. Generally, when you run the ISC model,
15 you do not allow the stability class to vary by more than
16 one stability class per hour.

17 That is standard EPA regulatory mode practice.
18 That's what you usually do. But in this case for these
19 field studies, when we fitted the emissions data, we did
20 not do that.

21 And the reason we did not do that is that I can

1 tell you from being there in the field at all of these
2 studies and being at the met station around sunrise until
3 7 o'clock staring at the instruments, what typically
4 happens in the desert like climate in California, and
5 those from Bakersfield really will know this, is that it
6 is calm as calm can be to the point where the vertical
7 propellent anemometer won't even turn.

8 That's real sensitive to wind. Everything is
9 dead at some points in time. Often near sunrise.

10 And then when the sun turns on and the ground
11 heats up, even just a little bit, it is almost like a
12 switch is turned. Everything starts spinning. It is
13 transitioned.

14 So the problem we face in that kind of a climate
15 with sandy type soil, low heat capacity, we get a rapid
16 transition from F stability to A stability.

17 I have to say, Dr. Barry, I did check on this
18 and I wasn't quite right when I said it would go within
19 one hour. That was a little bit of an exaggeration.

20 But it will go within two hours. There is a
21 little bit of a transitional period, but it goes from A

1 to F very rapidly. So in doing the fitting procedure, our
2 recommendation is to match on site expected conditions.

3 In using the model, if you are using this model
4 in Wisconsin or using it for heavier soil in the Pacific
5 Northwest, it may be appropriate to not allow the
6 stability class to vary by more than one stability class
7 at a time.

8 But we have to keep things very separate here.
9 The purpose of the onsite programs, meteorological data
10 collection, as well as the modeling, is strictly to
11 estimate the emission rate. That's all done for the
12 emission rate only.

13 When we want to evaluate variability say by
14 region, that's when you could put together, if you wanted
15 to, 10 years, I'm sorry, 10 data sets, five years each to
16 be your basis to 200 years. There you account for
17 variability.

18 Here we are just trying to represent in the
19 field proper characterization of emission rates
20 themselves. It is a different exercise. Related. You
21 want to do them in a consistent fashion. But there is

1 different objectives. That was the reason why that was
2 done the way it was done.

3 Just to show as an aside, this is showing --
4 this is based upon our sigma W data, standard deviation
5 of vertical wind speed. That's converted into the
6 standard deviation of vertical wind direction by dividing
7 that parameter by the average wind speed.

8 You can see that in the early morning hours it
9 is nice and low, real stable. And then the sun comes up
10 and it goes right up. About 12 to 14 degrees we would hit
11 A stability. So it did take two hours, but not by much.
12 And then you have your daytime regime going on.

13 The desert type environment is a little bit
14 different, fortunately, than the rest of the country.

15 Now, dispersion modeling, I will describe it
16 briefly. First, in terms of how we use it to do emission
17 fitting. Then I will describe how it is used for
18 computing the actual exposures themselves.

19 It is done basically the same way. You want to
20 be consistent. Because as was described yesterday, we are
21 sort of calibrating the model. We are making it work out

1 such that your emission rates will match what's observed.

2 So when we actually take those emission rates
3 and use it to characterize concentrations for that region,
4 we want to model the same way. We are characterizing the
5 emissions and the distributions based upon upper end data
6 set. But to extrapolate, we want to make sure that we are
7 consistent in our procedures.

8 Nothing very controversial in here. I think we
9 all in this room do it all exactly the same way. ISC is
10 run using the on-site meteorological data when you are
11 doing emission fitting. The emissions are normalized.

12 We may normalize it slightly differently. We
13 will check on that normalization question that came up.
14 We normalize using one microgram per square meter per
15 second. Mathematically, that's simpler and avoids any
16 confusion.

17 The model is matched to the monitoring sites in
18 the sampling periods. So we are trying to get matched
19 pairs of measured and model data points. That's the whole
20 purpose for this exercise.

21 And the field is treated as one area source.

1 There are times when the applications being put on by
2 shank injection that we have had it be a growing area
3 source during the application itself.

4 By chemigation, that's not necessary. They are
5 applying the entire area. But this is pretty standard.
6 Everyone does it about the same way.

7 In terms of modeling for FEMS and trying to
8 estimate distributions and so forth and buffer zones, at
9 that point -- we talked a lot about TOXST this morning and
10 why we are using it.

11 The difference here is we are taking the
12 emissions information that we learned from the field
13 study. We are identifying that 24 period emission cycle.

14 We are modeling that in ISC. Those results get passed
15 into the TOXST post processor. That's what is occurring
16 and that's been discussed.

17 TOXST is appropriate for acute exposures. Not
18 really designed to be used for long term exposure
19 assessment. 24 hours or less.

20 There are two ways that TOXST can be run. The
21 first one I will not get into. It can be run for a range

1 of emission rates. That was really for an industrial
2 application. The case of interest here is for batch
3 source treatment.

4 In TOXST, with a batch source treatment, you
5 tell it what the emissions are at different times of that
6 batch, how long the batch runs for and what the
7 probability is for that batch turning on.

8 For future reference, the AERMOD next generation
9 EPA model does have an output connection for supplying
10 data for TOXST. It has not been tested as far as I know.
11 It should be tested.

12 TOXST, to work with AERMOD, needs to have some
13 call changes made. We have had to make call changes
14 because EPA has not updated TOXST for the current version
15 of the ISC 3 model.

16 We have not verified the model except for
17 changing the call names. But that's basically what it
18 does. So the current version of FEMS is set to read
19 ISCST-3 input data.

20 I will repeat this. I have discussed some of
21 this before, but I just want to make sure these points

1 are understood. It is a little bit confusing. I think
2 one more time around won't hurt.

3 The important essential point of fumigants is
4 that the emission pattern is very much diurnally driven.
5 It is a diurnally driven damp each day pattern.

6 And I will repeat that that pattern can show the
7 peaks at night or it can show the peaks in the daytime for
8 metam-sodium. It depends how you apply it and how you
9 seal it. Either way it is very important we address that.

10 The difference between the two is profound. In
11 approach, when we have our worst case peak emissions at
12 night, we are coinciding worst case meteorology with worst
13 case emission rates, getting the highest concentrations
14 you can expect to see.

15 When they are out of phase and the highest is
16 happening in the daytime, they really aren't any higher
17 than they were before in the daytime, but the nighttime
18 has been reduced.

19 That's the situation. If you have that kind of
20 pattern, through research developed it, you sure want to
21 use that in your exposure assessment. What we need to be

1 able to account for the most important thing is accounting
2 for the diurnal pattern of emission rates in the TOXST
3 model.

4 Our judgment was the best way to accomplish that
5 was through the inputs. Was through using ISCST 3 as the
6 heavy lifter. It is doing all the work on the emission
7 side.

8 TOXST in this context is only turning on the
9 application, telling how long to read records for and it
10 is post processing the results.

11 Once again, what TOXST is doing is saying, okay,
12 the random number generator has hit a number that says an
13 application is starting now on this hour.

14 When that happens, it needs to read 96 records,
15 96 hours of output from ISCST 3. It will start at a
16 certain period number -- period number 5, whatever it is,
17 it will start there.

18 Work its way through diurnally matched. Get to
19 the end where there is a really low emissions. Then go
20 back to the first data, capture the high periods. Again,
21 diurnally matched.

1 When it hits the 96th record, it goes to sleep
2 again. It is waiting to be woken up again by another
3 application. Then it does this thing again and over
4 again.

5 If you simulate 100,000 years, which takes about
6 12, 14 hours to do, it will do that approximately 100,000
7 times. Another flow chart. And again, I will walk
8 through this a little bit. But the key thing in here is
9 the red.

10 The other aspects I'm describing here are
11 standard EPA modeling practice. Again, TOXST and ISC are
12 both EPA models.

13 When you make a FEMS run in the current
14 prototype, you are entering things like your latitude,
15 longitude. You are indicating how many acres you want to
16 deal with. You are identifying which data file to draw in
17 to show those 24 records of emission distributions.

18 What is happening behind the scenes is the
19 latitude and longitude and time zone are used to run the
20 met preprocessor for the location you want to model.

21 So it will process the meteorological data to

1 get it in the proper format for ISCST 3 through PCRAMMET,
2 then it will run the ISC model 200 times.

3 Before it does that, it needs to create the hour
4 by hour emissions and meteorological files that account
5 for uncertainty. It is creating those 200 years of files.

6 Then it's going to run the 200 years of files.
7 When you run FEMS, you see it is on run number 25 and then
8 26 and so forth, that's each year it is running for 200
9 years. It is doing that in eight blocks.

10 So it does take a while to do. The base runs
11 -- it is not designed to be a fast model. We have
12 designed the prototype to do as accurate a job as we can.
13 It could be shortened, I'm sure, in the future.

14 But it won't run in an hour if you are trying to
15 simulate 100,000 years of applications or 10,000 years of
16 applications because if you want to randomize, account for
17 randomized uncertainty in your met data, you want to run
18 200 based years, it is going to take time to do that.

19 You could shorten it by running less years. I
20 wouldn't recommend it.

21 The bottom line is let's say if someone wanted

1 to use FEMS to come up with tables for any particular
2 fumigant. In my judgment, run time in that context, with
3 the small numbers of users that are going to do this, it
4 is not a big factor, I can lease 10 very fast laptops for
5 a month to get that job done for probably about \$3,000 of
6 leased cost for the computers.

7 Could it be done faster? A little bit faster.
8 The short part is running TOXST. But the reason that --
9 that takes actually less time than the ISC runs. If you
10 are trying to simulate 10,000 years, it may take a couple
11 hours to run TOXST.

12 The computer processors today that run in, what
13 is it three gigahertz -- when TOXST was developed, we
14 bought a computer again that had 66 megahertz, the fastest
15 machine you could buy back in 1993.

16 So TOXST was a long running model. Five years
17 from now, FEMS will be running much faster when the
18 computers do get faster. But that's the basic procedure
19 that goes on when you set up the input files in terms of
20 the ISC part of the system.

21 What happens then -- it is also asking questions

1 in the set up file for FEMS what application rate do you
2 want to use. The data files assume 100 percent
3 application. Max label rate. And when you say I want to
4 do 50 percent, it is assuming a linear relationship as
5 often as assumed.

6 Linear relationship and scaling down from max
7 label rate to whatever percentage you want to use.

8 It is also asking for things like what is
9 probability for start time. And that's based upon the
10 region, the scenario you are dealing with. And you input
11 your regulatory endpoint concentrations. Up to six if you
12 are not sure. If you want to see more of a distribution
13 approach. You can't put in more than six per run.

14 You indicate what the allowable exceedances per
15 year is. In the future on this model it really should say
16 what percentile do you want to regulate at.

17 As an Air model, Air Office model, the air in
18 the United States typically is regulated by the exceedance
19 concept. They are interchangeable. It is just a matter
20 of semantics.

21 But that's the way it is tracking things within

1 the model itself. What is going to happen then is it's
2 going to run TOXST -- it is going to make 200 runs of
3 TOXST.

4 If you want to do a 200 year simulation, which I
5 wouldn't recommend doing, it would have one year run per
6 TOXST run. If you want to do 10,000 years of simulations,
7 it will have 50 per run.

8 The number of simulated years in each of these
9 runs will go up as the number of simulations goes up. But
10 it is going to do the TOXST runs and give output in the
11 form of exceedances per receptor.

12 Jeff Dawson showed that figure earlier on.
13 Internally, that's what it is doing. It is identifying
14 around that field for each of the receptors. We run 720
15 receptors through TOXST at a time. It will show you what
16 the exceedances are at each one of those receptors and
17 then through interpolation procedures we will compute the
18 buffer zone distances.

19 Now, if you as a risk assessor wanted to rather
20 than that, you wanted to see distributions of
21 concentrations around the field, you can do that with

1 TOXST.

2 It won't to do it automatically, but it is there
3 behind the scenes. A lot of things that could be done
4 with the output that's created from this system. We're
5 simply showing now in the prototype what the buffer zone
6 distances are as a function of endpoint concentration.
7 But there is a lot more behind the scenes than that.

8 Now, there has been discussion about the shape
9 of the field, and fields do come in different shapes and
10 sizes.

11 We think this is an important point. Much of
12 the work I have done is in California in terms of field
13 studies. From my experience in California, your typical
14 agricultural land plots, 160 acre quarter sections are
15 what a lot of the growers are dealing with.

16 If they want to put 160 acres into carrots, for
17 example, they are going to do it in what I have seen 20
18 acre sets. Let's say it has been done by chemigation, for
19 example, which would be 20 acre sets, typically.

20 If they had enough water available to do 20
21 acres at a time, which is about the most they usually

1 have, they would do eight skinny little strips because the
2 quarter section is a half mile long.

3 So you envision a 20 acre set is really going to
4 be, we showed in our default example, 100 meters wide by
5 about 800 meters long north, south.

6 It can be a square for small plots. FEMS does
7 allow you to have the shape you want as long as it's a
8 square or rectangle.

9 But in simulating what happens in California as
10 an example, you need the flexibility to be able to handle
11 20 acre fields orientated like that.

12 It makes a large difference in buffer zone
13 calculations because now the critical factor is where is
14 your prevailing flow direction relative to the long and
15 short side of that rectangle.

16 It can make up to a factor of 3 difference in
17 the conservatism in the results if it is not done as a
18 long rectangle compared to a square. I will show you the
19 reason why. This is scaled close to being correct. I
20 didn't get to rule (ph) exactly.

21 But if these are 20 acre sets, if it was square,

1 it would be 283 by 283 meters square. If it is a typical
2 set in California, again, it is 100 meters wide by 800
3 meters long.

4 The critical factor here is when you have the
5 winds coming from the southwest or the west, this kind of
6 arrangement has much longer fetch to pick up the off-gas
7 materials than when it is crossing a field like this.

8 Conversely, if we had a situation where a
9 region had prevailing flow from a north, south axis, such
10 as a valley situation, you could understate the case when
11 you have a lot of flow coming on this axis right here.

12 So in order to have the flexibility to
13 accommodate the various types of fields that you will see
14 out in the -- on the farm, we have given the use of the
15 flexibility to set the length and width. It does
16 complicate the interpolation. There is no question about
17 that.

18 We have spent quite a long time trying to work
19 out the interpolation procedure. We feel very confident
20 and comfortable now with the procedure we have. You can
21 get within 10 meters.

1 We describe how many simulations we recommend
2 doing. If you want to be double sure, you can go back and
3 refine your grid and do a second run. Make sure you got
4 it right. But we do round up.

5 So if you have a 51 meter buffer zone computed,
6 we'll call it 60. But that's the approach you have would
7 taken. But we do want to keep the geometry in the hands
8 of the user, basically.

9 Now, when it comes time to develop regulations,
10 that's a different matter. There will have to be
11 discussion with regulators such as DPR in California how
12 are you going to practically going to do this.

13 Some people could have squares and rectangles of
14 different sizes. That has to get discussed and worked on.

15 But scientifically, we want to have the tools that could
16 handle this situation.

17 This is a figure showing a comparison, a
18 hypothetical situation here. Showing distance to endpoint
19 here as a function of endpoint concentration, which really
20 is a function of distance.

21 As you are going towards the lower endpoint

1 concentrations, you are going further away. As you get
2 further away -- there isn't much of a difference between a
3 square and a rectangle.

4 But as you go to the higher endpoints or go
5 closer to the field, as your buffer zones become small,
6 actually, where, of course, it goes -- would like to see
7 them B (ph), if that's possible, you are getting the bias
8 to overstate by about a fact of 2 1/2 to about a factor of
9 3.

10 And frankly, we would like to minimize any
11 unnecessary bias either way.

12 By using -- having the ability to use
13 rectangles, if that's appropriate for the region, we can
14 remove the bias in here. And for perspective, this
15 distance factor in a buffer zone is very critical to a
16 grower.

17 Imagine yourself as a grower. You have a 20
18 acre plot like I described in the previous slide. You are
19 trying to apply this field here.

20 If you have a thousand foot buffer zone, that
21 means 200 acres around this location are in your buffer

1 zone. It is a little more than you might envision. To a
2 grower, that's a huge problem.

3 If you have a relatively small plot, that could
4 either give them two options. One don't apply, don't farm
5 there. Or break it into tiny pieces and they will
6 probably tell you I just can't do that or I don't want to
7 do that, whatever. So it is an issue.

8 The growers that we interact with aren't saying
9 that they want to underestimate anything. But the
10 challenge for all of us here is to try to be accurate.
11 Try not to keep in here any unnecessary conservatism.

12 Because it is not a one-sided risk assessment in
13 the end. The ability to have high yields and high quality
14 agriculture is important. There is a balance being walked
15 here. We are trying wherever we can to be accurate but
16 not to try to overstate. That's the basic goal of FEMS.

17 This before and after picture is showing that --
18 this is what the field looks like before we do an
19 application. Here is the carrots that came in the Lost
20 Hills.

21 Shank injection intermittent sealing produced a

1 nice carrot field. That is what is shown here. But
2 envision this row. This particular row is about a half
3 mile long.

4 A quarter section is a lot of land. And if
5 it's 160 acres, they have to do it 20 acres at a time, it
6 could take them eight days to get it done. As I'll show
7 later, FEMS is designed to handle that situation where if
8 you had to have a sequence that would go on for eight
9 days, that can be done.

10 Yes, it is a custom run. It is not designed to
11 automatically do that, but TOXST is certainly designed to
12 handled that feature. So randomly, a quarter section is
13 going to get applied.

14 We start with strip one. Go to strip two. The
15 off-gas is kept in sequence. It is on day one here. It's
16 on day two there. TOXST can accommodate sources that are
17 dependent in that manner.

18 It also can accommodate the situation where
19 there are independent growers independently can turn on,
20 maybe the same probability, but they probably won't cap it
21 on the same day. TOXST can handle that as can FEMS.

1 The bottom line here for the treatment of the
2 fields is we do want to treat them as area sources. We
3 want to be able to match cultural practice.

4 We want to account for how the emissions vary as
5 a function of time. We want to randomize those emissions.

6 We are in FEMS right now. We are updating
7 emissions on an hourly basis. I believe that the way that
8 PERFUM is updating is better.

9 I believe that doing the update in our case
10 every four hours would be more appropriate. And I would
11 consider that constructive change to the model.

12 It was tested. It makes about a 10 percent
13 difference in some cases in our results, but we are
14 computing, if you recall -- we are computing the best fit
15 for our mean emission rate. And then percent confidence
16 values.

17 So it really should be a four hour, I believe,
18 tracking of that. So you get the value for four hours.

19 We thought it would be more (ph) randomized on
20 every hour, but I would appreciate feedback on that point.

21 My thought is by doing every four hours probably would be

1 better statistically.

2 Treatment of calms was discussed a lot
3 yesterday. This is always a sore subject. And it gets
4 even worse. If you have 24 hour averaging, it is a little
5 bit different than if you are dealing with, say, four hour
6 averaging.

7 The issue is what is ISC doing with calms. You
8 have a regulatory mode, the calm processing option or you
9 have the no calms option.

10 For some reason, ISC was coded that if you are
11 doing three, eight, or 24 hour averaging, it processes
12 calms differently than if you are doing four hour or six
13 hour averaging.

14 Why does it do that? I really don't know.
15 Probably shouldn't have done that. But the way it works
16 out if you are doing four hour averaging and you have a
17 calm, it will assign a zero to that hour. It will average
18 that in.

19 If you had a 24 hour average and you had one
20 hour of the four that had a calm, it would just skip that
21 hour and base the average on the other three hours, which

1 makes some sense to me.

2 If you are in the nonregulatory mode, it assigns
3 a one meter per second value to the calms. One of the
4 questions we will discuss, I think tomorrow, we will be
5 asked that question, we could do this any various
6 different ways. Right now we are following the regulatory
7 mode. I think there may be better ways to handling that.

8 We are consistent. We do the fit that way and
9 the evaluation of exposure that way. But it might be
10 preferable to work that into the analysis and not treat it
11 as a zero. That's a question for the Scientific Advisory
12 Panel members.

13 I won't go through each line of this. But this
14 is just describing the various inputs to the FEMS model.
15 There is approximately about 12, 14 inputs for the model
16 that you are interactively asked to put information in
17 for.

18 The main point if you are running FEMS, that the
19 one that takes the work is the data file. The data file
20 describes the emissions distribution. You need to have
21 that to run the model.

1 That's chemical specific, application method
2 specific and sealing method specific. That requires some
3 homework on the front end to compute your emission rates.

4 Once that's done you can make the model run. We
5 set it up in DOS. I know a lot of people don't like DOS.

6 It could be put into a Windows basis. Not that much
7 difficulty to do that, but the prototype is in DOS.

8 Go to DOS. It prompts you for the various
9 inputs. You put the information in. And I usually
10 recommend doing your run before you leave in the
11 afternoon. It should be ready for you the next morning
12 when you come back to work.

13 This figure actually Jeff showed earlier. We
14 just plotted out and (inaudible) for the intermediate
15 results that come out of TOXST. There is quite a bit of
16 flexibility in the output from TOXST.

17 So it can output data that shows you again
18 concentration distributions by receptor if you wanted to
19 see that. Some risk assessors may want to see that.
20 That's the kind of information that could be linked with
21 the receptors to make it a full Monte Carlo system.

1 Right now it is Monte Carlo probabilistic for
2 the concentrations. We have done some sensitivity
3 testing, which is in the background document.

4 I did the sensitivity testing for two of the
5 four most recent GLP studies on metam-sodium.

6 The first series of graphs is for the test case
7 chemigation intermittent sealing. The next set is for
8 shank injection standard sealing.

9 I have done that to show some comparison. The
10 shank injection standard seal has more variability in it.
11 Higher emission rates.

12 This set has lower emission rates. I'm showing
13 various scatter plots. And somehow my concentration is a
14 mirror image. I don't know why that happened. But that
15 says concentration over here. This says emission rate.

16 This is based upon the long skinny area source,
17 one receptor to the north 150 meters away from the field.

18 I did that, assimilated a number of years
19 through the system. I just want to see how sensitive are
20 the concentrations to the various inputs in the model.
21 That is all it is doing.

1 I'm showing first how sensitive it is to
2 emission rates. You will notice this little gap right
3 here. That's just a coincidence. There is a gap among
4 the 24 periods in the record. If you look at the range
5 from 2.5 to 97.5 confidence to the mean, there is a gap in
6 there where there is no emission rates and that gap is
7 shown right here.

8 Generally, you would not see -- we don't see it
9 in the other ones, but you do in this one.

10 The main point I want to point out here which is
11 pretty typical of probabilistic modeling is that first of
12 all the high concentrations are happening when we have
13 high emission rates.

14 That's not really much of a revelation. That's
15 what you would expect to see. But the issue is you can
16 get some real outliers that will be happening every once
17 in a while and they will be much higher than the rest.
18 This will show that in the system.

19 But basically what we're showing here in this
20 case in this test that the concentrations are quite
21 sensitive to emission rates.

1 You fit a line through that data. You do get R
2 squared of .65. It is pretty well rated that way as you
3 would well expect.

4 This is showing the same feature showing wind
5 speed increase and again concentration over here.

6 What do we find? Again, no surprise. The
7 maximum is occurring during low wind speeds. Now we are
8 showing -- we have the maximum -- the real outliers are
9 happening very infrequently.

10 This flow pattern is to the north. I think it
11 is a 1,000 year simulation. And we get very few times
12 where these things will all align the same way, but they
13 will happen.

14 This is showing by wind direction. Again, this
15 is that skinny 100 meter wide, 800 meters long, this is
16 showing 170 degrees to 190 degrees. Our peak values are
17 within five degrees either side of the central point of
18 the plume of the area source.

19 And we are tending (ph) to get our peaks more or
20 less when you are aligned with the area source which is
21 also is a good thing to see.

1 Lastly, again, as you would expect, the highest
2 values in this case, yes, the highest values are happening
3 during neutral to slightly stable conditions. Maybe you
4 weren't expecting to see that. I wasn't at first either.

5 The issue here is that this is chemigation
6 intermittent sealing. The whole purpose of intermittent
7 sealing is to shut down "shut down" emissions at night.

8 So when we put a quarter inch of water down at
9 an hour before sunset and a quarter inch down a little
10 before midnight, we have put a water reservoir and we have
11 put water between the MITC and the air. And by doing so,
12 when we do F stability, the emissions are very much
13 blanketed by the water.

14 That was by design. That's the whole purpose
15 of intermittent water sealing. When you think about it,
16 that's really the way it should be. The next set of
17 slides will show it the other way around, that if you --
18 in this case it will be shank injection standard sealing
19 where we don't put extra water down before sunset.

20 First, I'll be showing the plot. This is
21 showing, plotting out the emission rates. This is for a

1 random run. I forget which this is for. This is showing
2 based upon 92 micrograms per square meter per second.

3 We ran through the simulator a number of times.

4 You are seeing what I think is a typical, maybe give me
5 your opinion, but a right skewed distribution where we
6 have many points below or at the near the line of the
7 mean. But we do have some points that are very quite far,
8 are skewed high.

9 And that is again due to the fact with that log
10 normal fit. We are skewing the upper tail distribution to
11 the higher side.

12 This is showing a correlation matrix.

13 Basically, we wanted to take a look at our inputs and see
14 how they were correlated.

15 The main point in looking at the concentration
16 -- and this one here is for the shank injection
17 intermittent sealing as an example, and the chemigation
18 was similar.

19 It is showing emissions is the one that's well
20 correlated with concentration. In this case, stability
21 had some correlation, .3, not a lot.

1 But we are finding among the different inputs
2 such as emission, wind direction, wind speed, these terms
3 are not highly correlated.

4 We did keep those draws totally independent. My
5 position is that this supports that position. If the R
6 values were .5 or higher, it is my understanding we
7 probably should have linked them. But we didn't see that
8 in these data sets.

9 If you look at shank injection intermittent
10 sealing, I'm going to go through the same slide I just
11 showed for the chemigation intermittent sealing.

12 It is shank injection intermittent I'm showing
13 here. Not shank standard, like I said before. Here we're
14 finding again that the correlation -- the scatter plot is
15 showing that emission rates in concentrations are linked
16 fairly well. An R square of .53 here.

17 Again, we are getting our high values with high
18 emission rates. But again, these are happening. When the
19 emission rates are high, the wind speed is low. The wind
20 direction is oriented in this case. Although this one here
21 also is intermittent. Let me see if I have labeled this

1 one correctly.

2 No, I'm sorry. This one is not labeled. These
3 labels say intermittent. It is not, because if I look at
4 the last one, stability, that's a standard seal.

5 Please make a note that these should say
6 standard sealing.

7 Again, looking at the wind direction pattern.
8 Again, it is going from 170 to 190. Very similar to the
9 last plot. Not much of a difference there.

10 You are also seeing again that these real higher
11 values are happening with low wind speed. This would be
12 expected.

13 And in the shank standard seal we are getting
14 our peaks during stable conditions. This showing 6 and 7,
15 but it is all stability class 6.

16 This is really showing the importance of
17 sealing. If you can control your off-gassing and have the
18 pattern where this doesn't happen, your buffer zones will
19 be lower and your exposures will be lower as well.

20 We also looked at the sensitivity to number of
21 simulations. I'm showing one example of that here again

1 for our test case situation.

2 We have done the X axis. I'm showing a number
3 of simulations. These are showing it from around 200
4 simulations as the lowest one up to about 20,000
5 simulations here.

6 You will get some bumping around initially to
7 get to up to say around 2000 or so simulations and it
8 stabilizes sooner. It depends upon what endpoint you are
9 looking at.

10 If it is a higher endpoint concentration, it
11 stabilizes sooner. As it gets to be a lower endpoint, it
12 takes a little bit longer to stabilize.

13 Our default recommendation is 10,000 years. The
14 TOXST model doesn't take all that long to run. So that's
15 not a bad default. I wouldn't recommend doing any
16 simulations below 2000.

17 As I am saying here, our recommendation is --
18 the system is fairly stable, 5,000 to 10,000 simulated
19 years.

20 If someone wanted to do an extreme value, what
21 is the probability of going above an IDLH or NOEL value,

1 would you recommend 100,000 year simulation be done to
2 capture that upper tail?

3 We did show holdouts where we would treat
4 different parts of the different inputs as not accounting
5 for uncertainty, where others you would account for
6 uncertainty.

7 When you do run FEMS, it allows you to treat any
8 one of these four terms, emissions, wind speed, wind
9 direction or stability as either being considered for
10 uncertainty or not. You make the choice.

11 The benchmark is shown in bold. The benchmark
12 is important because that's showing what the standard ISC,
13 TOXST model are doing. This is the agency model.

14 If we run it with the agency model, we get the
15 benchmark. If we run it different ways, we can show the
16 sensitivity. In these runs, I'll show you, is that for a
17 typical scenario -- in this example we used about 1.5
18 exceedances per year as our examples, it is not real
19 sensitive to these terms.

20 It is generally most sensitive to emission rate.

21 But on chemigation, intermittent sealing, we had a very

1 well controlled study. Our emission rates were fairly
2 low.

3 The ranges weren't that large. That was pretty
4 much under control. We didn't have that great a deal of
5 variability and so it didn't make a huge difference.

6 If you went out to 100,000 year simulation for
7 a very, you know, a long term, maybe a 50 year recurrence
8 interval, a run, then these upward tail alignments become
9 more important.

10 But what we are really showing here for a more
11 typical run, the (inaudible) input variability is not
12 generally a very large factor. Emission generally is the
13 most important one. And the met factors are of lesser
14 importance.

15 I don't want to go through each line. This is
16 in the report we did. But basically, the benchmark is in
17 bold. 630, 320, 140 and so forth is what it is showing.

18 The run where everything is randomized, except
19 stability, which we do not recommend randomizing, that you
20 are seeing these 600, 630 with 600, 320, 330, 150, 140,
21 not much of a difference in here. Nothing really that

1 stands out.

2 We do show one parameter at a time. If you just
3 vary one at a time, you can see from what is shown here
4 that the stability class in this example didn't make much
5 of a difference.

6 The holding out -- if we treated wind direction
7 as the only variable term, that does tend to lower it a
8 little bit and so forth. But by and large, it was not
9 real sensitive to these terms for a typical 1.49
10 exceedance per year concept.

11 For shank injection standard sealing where we
12 have a bigger range in our uncertainty and higher emission
13 rates and so forth, there are some bigger differences.

14 Our benchmark run is shown down here. What we
15 are finding when we go to the runs and review (ph)
16 emission rates, it does make the bigger difference,
17 especially at the lower endpoint levels. We had a 630 in
18 our benchmark, if you emissions only, it increases that
19 endpoint distance of 720.

20 If you put all three terms in here and make them
21 randomized for uncertainty, we find in that case then it

1 becomes much more similar. There is some compensation
2 going on in here.

3 So by and large we are not seeing extremely
4 large differences when you make all these three terms
5 randomized compared to the benchmark value itself.

6 The summary at that level review is that the
7 results are most sensitive to emission rates.

8 The probabilistic treatments for meteorological
9 terms -- it tends to offset somewhat the increase that
10 would occur for emissions only. Emissions tends to bump up
11 the numbers.

12 Randomization of wind direction and wind speed
13 tends to imbalance, take them back down again. The results
14 tend to be similar to the benchmark levels at that -- this
15 would be, for example, if you are doing four hour
16 averaging in a model run and you had 96 periods, one
17 exceedance a year, one exceedance would be about the 95th
18 percentile value for that active offgassing period.
19 That's what this is really showing. It won't be extremely
20 sensitive to those terms.

21 Now, in accordance with EPA guidance, we did

1 access the upper tail as part of the sensitivity review.
2 Now we're looking for .05 exceedance a year, a twenty year
3 recurrence interval event.

4 So .05 exceedances per year concept. The
5 benchmark is showing 240, 50 and so forth. And for the
6 chemigation intermittent, we get somewhat of a bump up.
7 Emissions only is 270. If we have all three terms, we get
8 up to 290.

9 So when you go to a longer recurrence interval,
10 now the meteorological terms are increasing the buffer
11 zone to some extent. Not a tremendous amount, but in this
12 case we're going from 240 to 290 meters buffer zone, from
13 50 to 80 and so forth.

14 So the sensitivity is larger when you go to the
15 longer recurrence interval events, which would not be
16 unexpected in my view.

17 This graphically is just showing -- this is
18 showing here graphically for the shank injection standard
19 sealing event. I'm showing the benchmark.

20 This is buffer zone distance in meters. This is
21 showing concentration. I apologize, this is dark. 2,000,

1 2,500, 5,000, 10,000, micrograms per cubic meter.

2 Our benchmark is the black line. If we were to
3 just randomize stability, it is taking away some of those
4 Fs inappropriately and is biasing the data low. That's why
5 we're recommending not to randomize stability until AERMOD
6 is linked up to this.

7 But if you do randomized wind speed, wind
8 direction emissions, you do find that at 2,000, 2,500
9 micrograms per cubic meter for this test example, one hour
10 averaging .05 exceedances per year for this particular
11 data set, that you are increasing your buffer zones due to
12 the randomization of uncertainty for those terms.

13 So our conclusions in terms of the upper tail 20
14 year recurrence interval example is that it is more
15 important then to consider both meteorological variability
16 and uncertainty and emissions variability and uncertainty
17 to characterize that issue.

18 Emission rates remain the most important most
19 sensitive parameter. And, I think, the important point is
20 the results are showing that our results are higher than
21 the benchmark run.

1 Again, the benchmark run is standard EPA
2 modeling practice. It is a point of reference.

3 I just did a surface, I did a response surface
4 here just to show how concentration endpoint and how the
5 -- how much endpoint and averaging time.

6 If you put these on a two dimensional surface
7 here and have your third dimension be buffer zone distance
8 for this particular example I ran here, which was shank
9 injection standard sealing, and it made quite a few runs
10 to produce it. I thought it was interesting.

11 It shows you that, and not unexpectedly, that as
12 you decrease your averaging time and decrease your
13 endpoint concentration, you will get a wild ramping up of
14 buffer zones. As you work your down, of course, it is
15 like a leaf that is tilted.

16 As you go towards longer averaging times, you
17 will tend to drop those concentrations, as you would
18 expect. And as you go towards lower endpoint distances,
19 of course, you drop them as well.

20 The interesting thing about this kind of a
21 function is you can use this for extrapolation purposes.

1 You can extrapolate either way you wanted to. Either by
2 averaging time or by endpoint distances. I will show some
3 plots. It extrapolates by a power function fit. Power
4 function fits both ways quite well.

5 That's important in a sense that if what if some
6 risk assessor somewhere sometime really wanted to do five
7 hour averaging. That was his real issue. TOXST will not
8 do five hour averaging.

9 But you could get the data by interpolation with
10 quite good accuracy by doing interpolation based upon four
11 and six.

12 This is showing the slices both ways. If you
13 fit a power function to the slice, here I'm holding
14 averaging time constant at eight hours and showing how
15 things change by endpoint concentration.

16 Again, it is showing a power fit to the data
17 quite nicely. We could interpolate by this without much
18 error.

19 Here I'm holding the averaging time constant and
20 varying the average time constant and varying the -- I'm
21 holding the concentration constant and varying the

1 averaging time. That's the opposite slice. Again, I'm
2 showing a power fit to the data.

3 So either way you wanted to slice it by
4 averaging time or by endpoint concentration, you could
5 interpolate with confidence in my view by making model
6 runs on either side of the averaging time of interest.

7 This question always comes up in in a regulatory
8 context because it is important. We have been describing
9 here so far one field. One field at a time. The question
10 comes up appropriately. What if a grower had eight fields
11 to do on day one, day two, day three, and so forth, or the
12 case where there is little island or a corridor of
13 residential area surrounded by fields that are going to
14 apply?

15 The best feature of FEMS in my view, one of the
16 best features, is that it can handle multiple field
17 scenarios. TOXST was designed to be able to handle that
18 type of source directly. So the issue is if it is a
19 multiple field of independent growers -- I don't recommend
20 assuming that it is the same probability across a year,
21 maybe the same probability for a month or a season. Let's

1 say they are planting carrots.

2 And you are going to assume that sometime that
3 month or that season that grower is going to fumigate his
4 field.

5 We are not going to assume it is going to be
6 exactly the same day. It might be the same day. In some
7 years it would be in the simulations. But they are
8 treated as independent events.

9 They each have the same probability of
10 occurrence, but they can be treated independently. Or if
11 it's a situation where the farmer is a big farmer and he
12 has 160 acre block, he is going to do it over eight days,
13 that's triggered as one event. And the plan sequence goes
14 on for 96 hours plus the last off-gassing.

15 It can handle either method. Not the way it is
16 structured now in the prototype, but the system can be run
17 that way without any difficult to do that. So when I say
18 custom run the background document, that means we can
19 make the run to do that.

20 FEMS prototype is designed to automatically put
21 the run together for you for one field. There is a lot

1 more that can be done because TOXST is creating output
2 that can be, of course, processed and used to handle these
3 other kind of scenarios, which could be incorporated into
4 the model once it goes through a review process like this
5 at some point in the future.

6 I have described these two scenarios. Let me
7 describe it from a block. The block diagram here, this is
8 a scenario that the regulators will discuss of concern.

9 You have a corridor. There is maybe a street
10 going this way and a street going that way. It could be
11 that there are homes all along this strip here along the
12 highway. But all the rest is agricultural land that can
13 and will be fumigated.

14 I just put the sets on one of them. Here is the
15 first example. This farmer here he can apply this whole
16 field. If you're going to do that scenario, that would be
17 an eight day sequential application scenario.

18 We may have four farmers that are going to do
19 the same thing. You might know for this part of the San
20 Joaquin Valley it's going to happen in June.

21 Your met data set then would be June data in

1 there. And you put a probability appropriate for that
2 cultural practice in that region into the model and
3 simulate 10,000 years, if you want to.

4 And these different fields will turn on in
5 accordance with the probabilities. If it's one time a
6 year application probability, it will happen 10,000 times
7 in each field.

8 Sometimes all four will be going at the same
9 time. Maybe once in a while it will set up exactly the
10 same day. Many times they will be running alone.

11 But you will be able to look at that
12 distribution in the end. I assume you want to see a
13 distribution from low to high of what can happen. That's
14 the purpose of TOXST or FEMS, is to show that.

15 Seasonal considerations, I'm not going to spend
16 a lot of time on that today, because the prototype version
17 I'm discussing is annual. But the issue is very simple.

18 If you want to do a seasonal run, instead of
19 putting a year's worth of data in there, put in the
20 seasons instead.

21 The model can be set up that way to put in

1 seasons or months. And that would then have the proper
2 meteorological data for that crop, let's say, you are
3 concerned about. Your probability is going to be matched
4 to those conditions.

5 But the two issues I'm talking about for
6 seasonal, there are two issues. One is meteorology.
7 Meteorological parameters we all well know vary by season.
8 So do emission rates.

9 If you had the luxury of having lots of data,
10 which none of us do right now, but if you have data to
11 show the function of winter versus summer, but the
12 differences were in emission rates, that could be factored
13 in, in the future.

14 Those are the two parameters, meteorology and
15 emissions are different that could be accommodated in
16 modeling system. Meteorological differences I want to
17 clarify.

18 How do conditions around the country vary
19 different times of the year that would produce high
20 impacts. I would say that California, the west coast in
21 general, especially in Florida, it is quite different than

1 many parts of the country.

2 There you will find you are going to get maximum
3 values perhaps in the wintertime. Many other parts of the
4 country, like the southeast, Great Lakes what you find
5 could be the other way around.

6 The reason being many parts of the country that
7 are in the storm system tracks like we are right here,
8 your wind speeds in the summertime are a lot lighter in
9 the wintertime.

10 If you look at monthly average wind speeds, they
11 will be higher in the winter, substantially higher.

12 You are going to tend to get more storm systems,
13 lots of time more precipitation in the winter, stronger
14 winds, less stable conditions. And that's a factor.

15 Florida, California, different situation. It
16 can be the other way around. So on a regional basis, it
17 is different. We should all keep that in mind. It will
18 not be the same.

19 Regional consideration is an important point, as
20 we have discussed a lot the last couple days.

21 I want to make one point clear in our system is

1 that when we do emission fitting, the meteorological data
2 collected for that fitting is not intended to represent
3 the variability around that region, around the country.

4 It is designed to estimate emission rates and
5 the upper end of the distribution. High end emission
6 rates.

7 What we are all concerned about in the big
8 scheme of things for exposure assessment is if you take
9 those emission rates from a location like Bakersfield in
10 the summertime, we want to represent the variability and
11 uncertainty in meteorological data so we don't
12 underestimate the tails.

13 To do that, we need to put in multiple years,
14 multiple met data sets to characterize the valley
15 situation, the coastal situation. That needs to be put
16 into model.

17 If you are doing a run let's say in California
18 where there may be, who knows, four or five subregions or
19 so for the state, and you wanted to use FEMS for that
20 purpose, one way to do that would be to identify a way,
21 take perhaps the 10 met stations in that region to

1 characterize the typical or the range of conditions, put
2 those 10 data sets into FEMSSs, instead of putting in the
3 one five year data set, put it in the 50 year data set.

4 By running that to simulate your 200 base years,
5 you are doing a more complete job of characterizing
6 regional variability and uncertainty.

7 If you want to do it on a national basis, it is
8 the same concept. How many stations you need would be up
9 for discussion. You have the Great Lakes, you have
10 Florida, Pacific Northwest, California. It is a
11 negotiable point.

12 Industry, EPA, DPR get together and figure out
13 how to approach that problem. How to pick the stations.
14 Those stations could be used for all fumigants.

15 But that would describe the variability. We
16 won't capture every place. We could capture in a
17 reasonable way a wide range of expected conditions that
18 way for all fumigants.

19 They would all be in the same footing, be
20 consistent. It could be done once. Everyone could use
21 the same use the same data sets. That would be a

1 reasonable goal, I think.

2 That's really where we stand right now, believe
3 me, I'm almost done. Sorry, I'm taking so much time. I
4 have described what has been done.

5 I should acknowledge the work that I have done
6 here has been sponsored by the Metam-sodium Task Force and
7 Amvac. They sponsored this work.

8 We have taken it to this point. There are, of
9 course, things that can be done with a system like this
10 that could address other factors, distributions of
11 concentrations, distributions of milligram per kilogram
12 per day and so forth.

13 Let's briefly touch on those things and then we
14 can go on from there. First of all, once this Scientific
15 Advisory Panel process is completed, I fully expect we
16 will modify our mission fitting procedure to match the
17 consensus approach.

18 I'm hopeful when you folks release your report
19 that we'll be able to have a group of people sit down,
20 Terri Barry and her folks from California, maybe Chuck
21 Peck and Jeff Dawson from EPA, Rick Reiss and others, sit

1 us down in one spot and come up with the consensus
2 approach that works for everyone that represents best
3 science, that's practical. That's where we should head, I
4 think.

5 In terms of emission procedure, we expect to
6 change it. That's an input to our system. But I'll just
7 point out right here, the updating procedure, how often to
8 update the emission fitting, as I mentioned before, I
9 don't (ph) think there is a better way to do that that
10 would make that change or updating in accordance to the
11 monitoring studies themselves.

12 This is just showing one example of what that
13 effect did in the testing we have done so far. We did a
14 couple of tests in showing the buffer zones. It didn't
15 make a very big difference.

16 In one case, just explain it, we are showing
17 here buffer zone distance in meters. We are showing MITC
18 concentration endpoints here.

19 And the red line is showing if we update every
20 hour the emissions uncertainty. And the blue if we do it
21 the way that PERFUM does it by the fundamental averaging

1 time.

2 We get a little bit higher values with the
3 Florida updates for that scenario. I think that would be
4 a way that it could be done in the future. It is a rather
5 easy change to make in the system.

6 That's just another example of the same point.

7 I'm going to just -- I don't have to go through
8 the rest in the interest of time. Just close by saying
9 that we are just addressing air concentrations.

10 And I know that EPA ultimately wants to deal
11 with milligram per kilogram per day. There are some good
12 databases out there that provide the basis to define by
13 variate probability distributions for receptor population
14 weights, breathing rates.

15 That kind of information could also be treated
16 in a system like FEMS to output not just concentration
17 distributions, but exposure distributions.

18 That's something that could be done. I'm just
19 throwing that out for future consideration. With that
20 I'll close. First, I'll see if there are any questions
21 that need to be addressed before I sit down.

1 DR. HEERINGA: Thank you very much, Mr.
2 Sullivan. I'm sure there will be some questions. Dr.
3 Majewski.

4 DR. MAJEWSKI: Once again I'm a little confused.
5 It could be a semantic problem. But I keep hearing the
6 correlation between air concentration and emission rates.
7 And where you have high concentrations at night during
8 stable conditions are equated to high emission rates.

9 It has been my experience that, yes, the air
10 concentrations at night when it is very stable are high,
11 but the concentration differences with height are low and
12 that equates to an emission rate or flux being low.

13 MR. SULLIVAN: That often does happen. What we
14 found in those reference studies that I showed as being
15 standard sealing methodology, what we found in those
16 studies we have a situation where the ground was dryer in
17 the studies we did after that point in time.

18 That when you have a transition going on in the
19 soil, soil air atmosphere interface, we are finding at
20 night in those particular studies both of them that we had
21 higher emissions at night as well as restricted

1 meteorological conditions.

2 And why that occurs, I mean, we could probably
3 discuss that for hours. That wouldn't occur if you had a
4 tarp on it from what I have seen.

5 It doesn't occur when water management is
6 tighter and there is more of a water reservoir. But what
7 we were finding there is that when that surface layer does
8 tend to dry out, your heat capacity issues are involved,
9 how stable that bottom layer is becoming in the
10 atmosphere.

11 There is issues there that we were finding much
12 higher concentrations that did not relate to the increase
13 in concentration -- the dispersive issues didn't explain
14 it.

15 It did appear that at night under those
16 conditions we could get higher emission rates under those
17 scenarios.

18 That's what led to the research to find ways to
19 ensure that as nighttime falls and the eversion (ph) comes
20 that we can shut that down and make sure we get very low
21 emission rates at night.

1 DR. HEERINGA: Just a note to panel members as
2 you are probably well aware of this, a distribution of
3 this excerpt from Statistics for Environmental Engineers
4 by Bertow (ph and Brown. Any other questions for Mr.
5 Sullivan at this point?

6 Dr. Spicer.

7 DR. SPICER: I just had one question with regard
8 to the time series smoothing technique. That's not mass
9 conservative, is it?

10 In other words, the area under the curve for the
11 raw data is not necessarily the same as the area under the
12 curve for the smooth data.

13 MR. SULLIVAN: I believe you are correct. We
14 didn't try to adjust that time series for that. That
15 would be a good idea. And again, that could be done, but
16 it was not in those figures.

17 DR. HEERINGA: Dr. Portier and then Dr. Wang.

18 DR. PORTIER: In thinking about the process you
19 used to simulate the period flux values in the simulation,
20 each period is randomly generated from its mean and
21 standard deviation. Right?

1 MR. SULLIVAN: Correct.

2 DR. PORTIER: And I think you looked -- maybe,
3 it is kind of confusing, you looked at the correlation
4 between, pairwise (ph) correlation between neighboring
5 periods and you found a small correlation? Am I quoting
6 the --

7 MR. SULLIVAN: No. We didn't look at
8 correlation between periods. No. We treated each periods
9 independently.

10 DR. PORTIER: The point I'm trying to get at,
11 you know, this idea of mass balance seems to imply that if
12 I look at the whole set of emission rates over a four day
13 period, there has got to be some dependency.

14 Because as the stuff outgasses, there is less
15 there, there is less drive for it to outgas. So it is
16 going to go slower. So generating these things
17 independently, and this is not unique to your model, but
18 generating it independently kind of misses this dependency
19 that has to be built into the process because of the fact
20 that there is just so much chemical there, there is just
21 so much that can leave and it can only leave so fast.

1 I wondered if you had looked at not just within
2 one study, but across your studies to see if there is kind
3 of period to period correlations or relationships.

4 Now, what that would mean for your model is
5 instead of doing simple random numbers, you would have to
6 do multivariate random numbers for the whole flux set.

7 MR. SULLIVAN: That's a very interesting point.
8 We have looked at the patterns. What complicates this is
9 that it does depend upon the application sealing method.

10 It is not the same for all the applications, but
11 let's say you isolated it to chemigation intermittent
12 sealing, for example. I think what complicates things
13 when you look at the dependency between period to period
14 is the fact that we are getting these diurnal oscillations
15 going on.

16 And those diurnal oscillations -- but they could
17 be repeatable, I suppose. I mean, your point is if it
18 when from high to low between period 1 and 2, may be the
19 same thing the next time it had that cycle going on.

20 DR. PORTIER: I'm removing the mean. I'm just
21 looking at auto correlation in a sense, temporal

1 correlation, and the fact that these things somehow have
2 to be related.

3 Well, maybe they don't. Maybe that's just it.
4 Because flux is to a certain extent related to the climate
5 that's going on. That's the whole point, you are saying.

6 MR. SULLIVAN: You are independently calculating
7 it at that point in time. But your point could be that
8 let's say you missed a number. You have a data gap.
9 Could that kind of correlation be helpful in filling that
10 gap? That's probably true.

11 DR. PORTIER: I was thinking more like if I
12 already knew that there are five periods that have gone
13 by. Does that somehow give me some information on what is
14 going to happen on the distribution at the 5th time
15 period?

16 MR. SULLIVAN: I think that it does. On the
17 last, in the test case study I'm showing here, you notice
18 those peaks dropped off pretty rhythmically.

19 It probably would tell you that. A lot of it
20 depends I think on how well designed your study is. How
21 well you are capturing that plume.

1 But I think there is a lot could be done with
2 what you said in terms of data filling procedures, what is
3 the best way to fill in missing numbers, what can we learn
4 from other cycles. Maybe in addition to the splime
5 approach you mentioned earlier. Could be something that
6 we could consider.

7 DR. PORTIER: I had a second question. On the
8 multiple field scenario, where are your -- where is your
9 grid, your response grid? How do you lay that out?

10 MR. SULLIVAN: On that scenario there, the only
11 response -- the response that would really count would be
12 along those residential areas on the T. Because the rest
13 of it is all farm fields.

14 You could lay out your receptors to be all
15 throughout the entire area and just show the risk assessor
16 what the concentration fields look like in distributions
17 throughout.

18 I would assume if they are the most areas of
19 concern would be the ones along the T where the homes
20 would tend to be and to focus on those, make sure you have
21 receptor coverage up and down the T.

1 Not randomly, very systematically placed along
2 that T.

3 DR. HEERINGA: Dr. Winegar and then Dr. Shokes.

4 DR. WINEGAR: My question right now will be
5 answered when we're talking about chemistry. But I
6 noticed in your spreadsheet Kern 2001.dat, or something I
7 think, it says, the heading is Recovery Adjusted Data.

8 Does that mean recovery from your absorbent
9 tubes that you used to collect the data, I presume?

10 MR. SULLIVAN: Correct. There is field
11 fortifications that are done in the field. And they are
12 analyzed in laboratory. Often you may lose 10 to 15
13 percent of the material.

14 And so what we have done is scaled it up to make
15 sure that we have 100 percent to account for the loss that
16 could occur in the sampling line itself in transport and
17 the laboratory.

18 It is a conservative scale up factor to make
19 sure we don't understate the actual measured value.

20 DR. WINEGAR: You say that was based on field
21 spikes and that kind of thing.

1 MR. SULLIVAN: Field spikes. In those cases
2 they injected the tube with liquid MITC. It was put in a
3 sampling line and then taken back for analysis like all
4 the rest of the samples.

5 DR. WINEGAR: My other question is in regard to
6 the study design for these field studies. Have you
7 thought about doing something like using maybe you or
8 someone else can comment on whether this is going to add
9 much, using something like sonic sensors that can give a
10 higher frequency and perhaps a lower threshold for wind
11 speed?

12 MR. SULLIVAN: We haven't used those, but that
13 is a good idea. Like I said, the complication is all
14 these low wind speed periods. I think that's an excellent
15 idea.

16 DR. WINEGAR: Along those lines, we talked a
17 little bit yesterday about more frequent samples, a
18 larger data set in effect in order to fit against.

19 Something to be considered.

20 MR. SULLIVAN: I think there is a trade off
21 there. One side of me says I would like to have more

1 samples. We all like to have more samples.

2 But the downside is that as you go to -- let's
3 say in the extreme if you could do one hour sampling,
4 which you can't, because you can't change the tubes that
5 fast, but if you could, the problem there would be we
6 would have such limited coverage at each of the sampling
7 sites, you probably wouldn't get a good fit.

8 As you get into longer averages, your ability to
9 fit the data becomes better. Your ends go up. The
10 uncertainty of the modeling goes down and so that equals
11 the other way there.

12 There is optimal level somewhere along the line.

13 I used to use four hour averaging. In the last study I
14 have done I did it with six hour averaging.

15 I kind of think six is good in the sense it does
16 let more of the samplers get hit. The field crew is a
17 lot happier too because they are changing tubes every four
18 hours, you don't get any sleep. Six hours is much easier
19 to implement.

20 Yes, it is a trade off. I'm not sure there is a
21 right answer. But those are the competing issues we have

1 to deal with.

2 DR. HEERINGA: Dr. Shokes.

3 DR. SHOKES: What kind of temperature extremes
4 are you looking at there in the Bakersfield area?

5 MR. SULLIVAN: During the shank injection,
6 intermittent sealing study, the afternoon of the
7 application day or the day after was above 100. I think
8 it went up to 105, 108.

9 The chemigation intermittent sealing was high
10 90s, low 100s. I could tell you for sure, the data. But
11 it is something like that.

12 DR. SHOKES: What are your night time?

13 MR. SULLIVAN: Night time, it drops quite a bit.
14 I'm guessing now. I don't have the data here. I would
15 guess down to the 70s or so.

16 DR. SHOKES: What would you project then --
17 let's say for example that's one extreme. You are in a
18 desert. What about Florida where you are in the
19 subtropic?

20 MR. SULLIVAN: I would expect to see lower
21 temperatures in Florida. Florida, of course, has sandier

1 soil. When we say sandy soil in California, it is sandy
2 soil. But if we are talking about Florida, some places
3 are like beach sand.

4 So it is different in California. There is no
5 question on that.

6 DR. SHOKES: You won't get the temperature
7 extremes --

8 MR. SULLIVAN: No. It is moderated by the ocean
9 to some extent there compared to what it would be in
10 Bakersfield. I wouldn't expect to see the extremes. No.

11 DR. SHOKES: Let's go to another area. Let's
12 say Southern Virginia. We fumigate with metam-sodium,
13 maybe 60 to 65 degrees soil temperature during the day.
14 Might drop down in the high 40s at night.

15 What would you expect to happen with emission
16 there?

17 MR. SULLIVAN: I would expect to have emissions
18 there to be quite a bit lower than what I'm showing here.

19 The studies that -- and Scott's point is well taken about
20 the fact there are many variables here.

21 But the studies done, say, in the Netherlands or

1 in Wisconsin where they are done in the fall, temperatures
2 may be 50 degrees, for example. They get very low emission
3 rates.

4 So it does seem to be a very important factor.
5 Conversion may be a little slower. But volatilization
6 clearly is less during those conditions that I have seen,
7 the studies I have seen so far.

8 That certainly is within label range, 40 to 90
9 degrees. It would be appropriate to apply it. But I
10 would expect emission rates would be substantially less
11 than I'm showing here.

12 DR. STOKES: In terms of cultural practices
13 relative to that adjusting, you used intermittent sealing
14 in your area because of the extremes of temperature.
15 Right?

16 MR. SULLIVAN: Used intermittent sealing in
17 California because of the extremeness of temperature and
18 because there is so limited water available naturally out
19 there that many of the growers do have irrigation lines.
20 They use them.

21 In the Pacific Northwest, another example, the

1 study we did there was power rollers because they don't
2 have available water. They have to deal with natural
3 water there.

4 Intermittent sealing is not the answer for
5 everywhere. In fact, it is not needed in many places. It
6 depends on soil type. Those soils up in the Pacific
7 Northwest seal very well with a power roller.

8 We did a study in the summer of last year. It
9 showed good control with a power roller there.

10 So it is very much site specific, I think,
11 different cultural practices, different water
12 availability, different applications, sealing methods.

13 DR. STOKES: Typically, in our area we would use
14 a shank injection with a raised bed with just a
15 mechanical seal on it.

16 And that works quite well. In fact, we can't
17 plant for about two weeks after that. It is safe after
18 two weeks. I'm figuring it is probably taking 10 days to
19 break down.

20 How well does FEMS handle all of that, different
21 scenarios like that?

1 MR. SULLIVAN: Well, FEMS is dependent upon
2 these data files. It is depending upon fitting the
3 emissions information where it can handle any averaging
4 time, well, essentially any averaging time below 24 hours
5 and it can accommodate square fields or rectangular
6 fields.

7 It has the flexibility to address these kinds of
8 needs in multiple fields, but you have to feed into it the
9 emission rates that are appropriate for your location.

10 In your situation at this point in time you
11 would be using the data from California which would be
12 conservative. It will tend to overstate the exposures in
13 Southern Virginia during those periods of time. That's
14 our expectation. But it is data limited.

15 If you had data collected at more locations in
16 different temperature regimes, different soil types, you
17 then have the ability to back off these higher numbers and
18 be more accurate for those other locations.

19 DR. HEERINGA: Dr. Wang and then Dr. Hanna.

20 DR. WANG: My comments or questions has to do
21 with your consideration of field geometry in the FEMS

1 model. I think the approach is commendable because you
2 rarely only see square fields.

3 But the question is that on the example you gave
4 by comparing the square or rectangle fields, since the
5 implication is to define buffer zones it appears one
6 example you gave saying that the buffer zone for the
7 square will be greater because the concentration is higher
8 in all directions compared to the rectangle.

9 But the physics would tell us that if you have a
10 rectangle field, that means the concentration in the
11 longitudinal direction is going to be much longer than in
12 the short direction. So that not necessarily mean that
13 depends which direction you are, the buffer zone may --
14 will be very different. It is almost directional
15 dependent.

16 MR. SULLIVAN: It is very much directional
17 dependant. And the example I show was from Fresno.

18 The situation is if you have a situation with
19 the winds out of the west through southwest, which is
20 pretty typical for a lot of areas in the U.S., under those
21 conditions the square will give you a much higher

1 concentrations, much bigger buffer zones.

2 For the situation where the winds -- it is in a
3 valley situation, or if it's north, south, under that
4 scenario, the square field would be expected to understate
5 the actual exposure.

6 Because I showed the example of the 800 meter
7 long by 100 meter wide field. That's a half mile long
8 field. If you are going down that entire segment of that,
9 there is going to be a high number at the end.

10 Where if you are going across, it would be much
11 less. It is very much depending upon the meteorology for
12 that particular area, region. That's why the seasonal
13 analysis is much more pronounced with a rectangular field
14 than a square field.

15 A square field won't show the wind direction
16 sensitivities. With a rectangular field, it will.

17 DR. WANG: I agree. But if you want to treat
18 that from a probabilistic approach, say it's random in all
19 directions, if that's the safest way you want to go in
20 terms of risk assessment, then the distance probably
21 should be longer, in the longer direction, I think.

1 MR. SULLIVAN: Well, the way FEMS is structured
2 is that you are trying to represent cultural practice and
3 meet regulators' needs. It has to be practical in the
4 sense to enforce. But let's say it is practical to
5 enforce, meaning cultural practice, and the fields are
6 long, skinny fields. The application is long, skinny
7 fields.

8 Well, then, you are going to set the buffer zone
9 based upon the direction from that field that has the
10 highest impacts.

11 It's all probabilistic, but in FEMS, identifying
12 a buffer zone is such that all points at distances that
13 far away from the field are more -- are protected. It is
14 lower than the endpoint concentration for that percentile
15 that was selected.

16 So if it is driven by the long side, that would
17 be the basis for the buffer zone. So the locations and
18 the seasons when it is coming out of the south or north,
19 the buffer zones will be quite a bit larger. When it is
20 coming from the west, the buffer zones will be smaller.

21 DR. WANG: Thank you.

1 DR. HEERINGA: Dr. Hanna.

2 DR. HANNA: My question is related to emissions
3 and coming from a kind of a larger scale kind of modeling
4 application and as you mentioned for the example the
5 nature (ph) TOXST work.

6 And emissions in the kind of even the gas phase
7 chemistry related to ozone and on road, off road, mobil
8 sources, we can get a feeling of how much uncertainty in
9 the emission.

10 It is quite large. It could be a multiple of
11 two and maybe sometime larger for certain kind of
12 applications.

13 And as the questions that I have, were you able
14 to get any feeling from this kind of, say, small scale or
15 micro scale applications how much uncertainty in the
16 emissions flux rates that are being calculated?

17 I didn't see -- there is no kind of evaluation
18 with measurements in this kind of study. But will you be
19 able to get the feeling how much of it -- probably it is a
20 dependent on the kind of methodology or applications used.

21 Or were you able to get any kind of feeling for

1 how much we expect in the uncertainty for emissions?

2 MR. SULLIVAN: I think we have an idea. I mean,
3 based on the data we have collected so far, we have
4 addressed, I will describe here today, four different
5 application sealing methods.

6 And for those methods, we have computed emission
7 rates with standard errors for each of those periods. So
8 that gives you an idea of the uncertainty or on the mean
9 in each case.

10 So there is a basis to assess how accurately are
11 we estimating -- what uncertainty do we have in each of
12 those numbers. So from the standard errors and the
13 distributions, I think we have an idea of that.

14 I guess the issue is if you were to replicate
15 this in other locations would you see the same thing.

16 And the studies I have shown for September of
17 2002 where we showed some very similar studies for
18 chemigation and shank injection, both were intermittent
19 sealing, we had similar release rates.

20 So that's one example that we were able to go
21 and do a similar study under similar conditions in Kern

1 County, a little bit cooler temperature, but still pretty
2 hot.

3 We haven't done as many studies, of course, as
4 anyone would like to do. These studies are expensive, as
5 you all know. But the issue, I think, that really is
6 important is that we are starting with the upper end side
7 of the emissions data, which tends to make it
8 conservative.

9 We have at least done another confirmation of
10 that and got some results for two important application
11 methods.

12 So I feel fairly confident that we are capturing
13 the upper end fairly well in the distributional sense.

14 What we are missing, I think, is being able to
15 describe in the cooler temperatures, different soil types
16 how much those numbers tend to drop down.

17 DR. HANNA: Is the type of application is
18 something that can be controlled or that's up to any kind
19 of -- the choice of the method for application, is that
20 something optional for anybody to use?

21 MR. SULLIVAN: The growers can be limited by

1 water availability and by the cost of the equipment in
2 some cases.

3 For example, drip irrigation is a low impact
4 method. Drip irrigation is only feasible for crops that
5 have high enough value that they can afford to buy the
6 equipment and where there is enough water to apply it. So
7 they can be limited in that capacity.

8 Chemigation is similar. Do they have the
9 piping to do the irrigation sets and the water to do it.
10 Because if they don't, they are looking at doing the
11 applications by shank injection and sealing by power
12 rolling or rollers or sealing by tarps or some other
13 method.

14 It is dictated by the value of the crop and also
15 by the cultural availability of water and other things.

16 DR. HEERINGA: I believe Mr. Dawson has a
17 comment on this and then we'll go to Dr. Ou.

18 MR. DAWSON: I was just going to say, I would
19 think at least our plan at this point is to carry those
20 distinct methods of application through the process.

21 This is very analogous to other types of

1 chemicals that we look at where there are different, you
2 know, different application techniques or whatever that
3 lead to different levels of exposure.

4 So we would perhaps as an example, you know,
5 carry it through with specific label recommendations on
6 one method versus another and look at the specific
7 limitations associated with each. And that's a very
8 common way that we do business.

9 DR. OU: Mr. Sullivan, I know that you come to
10 Florida to conduct two (inaudible) studies last year. I
11 wonder how your results fit to your FEMS model based on
12 the Florida result.

13 MR. SULLIVAN: The studies from last year?

14 DR. OU: Yes.

15 MR. SULLIVAN: Last year we did several studies
16 under USDA grant. Those studies were done on a short --
17 generally, two day studies, eight monitoring sites each.

18 They weren't really designed to capture enough
19 data, in my judgment, to fit distributions to.

20 So in order to fit the distributions and do it
21 well, you need more monitors and more time. We were

1 trying to get a sense of the general, best fit emission
2 rates in those studies rather than trying -- what I would
3 have liked to have done is distributions, but there is
4 just not enough data there to support that.

5 If you gave us a few periods, we could define
6 it. But without enough data, it is very hard to do the
7 distributions. There is too much uncertainty.

8 DR. HEERINGA: Dr. Bartlett.

9 DR. BARTLETT: I have some questions about the
10 weather data inputs.

11 From what I understand you add uncertainties
12 that you got from the surveys that you did with different
13 experts. So then what the result is is that in each
14 successive period a disturbance factor is added within
15 that range of uncertainty?

16 MR. SULLIVAN: Yes. We are taking the
17 sequential meteorological data as is, assuming that that's
18 the best fit information. Then for each of the hours as
19 we process the data we will draw from within 95th percent
20 confidence interval of the mean.

21 That survey was not mine, but it was in the

1 literature. It was done by Dr. Stephen Hanna.

2 DR. BARTLETT: That's somewhat random. It seems
3 like the net result would be a very unusual weather data
4 set, to me.

5 Like when we are involved in looking at the
6 quality of a data source and looking at the patterns like
7 for wind or any of the others and we see these
8 fluctuations going on when generally there is more smooth
9 trends going on with particular data sets, if you look at
10 those data sets as constructed to -- they develop unusual
11 patterns.

12 I guess -- if they had a prevailing wind, it
13 would have a mean wind speed and direction that may
14 gradually shift or there may be some rapid shifts as well
15 then be sustained in another direction.

16 So I assume yours would be kind of wandering
17 back and forth from a mean wind speed sometimes.

18 MR. SULLIVAN: Well, the mean, for example --

19 DR. BARTLETT: Would that be a typical pattern
20 that would come out of this manipulated weather data set?

21 MR. SULLIVAN: Well, yes. Basically, the issue

1 really is how large are the ranges. When this survey was
2 done they spoke to a number of experienced meteorologists
3 and asked their viewpoint on it.

4 So we have a wind speed. That range was like
5 one meter per second. It is not making large shifts.

6 Where the larger shifts come in is on wind
7 direction. And the consensus there was that as you get to
8 the low wind speed event situations, you really do not
9 know those trajectories as well.

10 And you are seeing more scatter in the data set.
11 It will fluctuate more than it would if you didn't put in
12 that factor.

13 And the reality is that if you were to go out
14 into the field and be able to tag puffs as they go over
15 the field, you are going to see that mean wind direction
16 that you quantify for the hour is made up of going this
17 way for a while and going that way for a while and
18 wandering back.

19 This approach tries to take that into account.
20 Simplistically, yes, the alternative would be to use a
21 puff pile (ph) approach to track these plumes up and down.

1 But the reality is when you have the light wind
2 speeds, the wind direction is erratic. And when you look
3 at actual average data, you are losing that resolution.

4 DR. BARTLETT: I guess what I'm concerned about
5 is the real world case where you have a prevailing low
6 wind in a particular direction, which is, I believe, one
7 of the scenarios where you have high concentration in one
8 location.

9 And that this, in other words, you have
10 something, a prevailing wind going west or something like
11 that. And you have -- this would result in something in
12 reality flipping around, which would result in a lower
13 concentration than you would get in a normal case.

14 So it might actually depreciate the -- decrease
15 the predicted air concentration by adding these changes in
16 directions.

17 Now, that's one case. And I'm not sure how it
18 would work out in other cases and how these shifts happen.

19 I believe you are correct that when you get the lower
20 wind speeds it is very typical for these to go around.

21 And going back to the data sources, though, if

1 you are using one station, NWS station, yes, there would
2 be uncertainty in these factors, but I would assume that
3 there would be somewhat of a calibration process --
4 getting out of calibration. There is a drift from what I
5 understand in some of these instruments.

6 So you may be off by point -- a certain
7 percentage off the mean. But it would be systematic in
8 one direction. It wouldn't be flip flopping around from
9 one plus or minus, plus or minus.

10 So it is a type of uncertainty you are putting
11 in there, probability distribution. And I guess I'm
12 trying to see whether it is -- if you are trying to
13 construct more weather data sets out of five years that
14 are realistic, that that wouldn't be the case of how you
15 would do it.

16 But from what I understand your intention more
17 is to introduce a probability distribution on the input
18 that would result in a probability distribution on the
19 output, which is slightly different that I'm just trying
20 to get used to in these few days here and what the
21 consequences are.

1 MR. SULLIVAN: That's a really good question.
2 It can go either way, though. For example, if I take a
3 five year data set and I'm doing 24 hour averaging, a very
4 critical important factor will be during the nighttime
5 stable period how much wind persistence did it have in one
6 direction.

7 Or let's say it is well controlled intermittent
8 sealing approach where the daytime situation is the
9 maximums.

10 Well, if I have steady winds in one direction
11 for a long time, which with moderate wind speeds can
12 happen more this way -- if you did a many years
13 simulation, you will get some of those years with much
14 more persistence than is in the base data set.

15 You could get eight hours in a row of one wind
16 direction going towards the receptor as a long recurrence
17 interval event, which you would not see in the original
18 data.

19 So it can go either way. For the moderate wind
20 speeds I would say you can get higher concentrations. For
21 the lower wind speeds, it is trying to represent the

1 reality of those trajectories.

2 So you can get lower winds. But of course, the
3 ranges and distributions, they are up for discussion, they
4 can be changed.

5 If folks believe that the way that wind
6 direction randomization could be done better, that can be
7 changed. It's just these are inputs. We propose those
8 that were based upon in the expert solicitation survey
9 that Hanna could be reassessed and redone.

10 That is the reason why it is the way it is now.

11 I think it does go either way. It doesn't necessarily
12 make the numbers get higher or lower. It depends upon the
13 scenario you are dealing with.

14 DR. BARTLETT: Now this is kind of more a basic
15 question. But aside from the probability advantage, if
16 you had access to 200 years of weather data or in the case
17 of your emission data, the air concentration data you used
18 to backtrack an emission, if you had 10, 15, 20 fields in
19 the same location, if you had some sort of data set like
20 that, would you model differently?

21 Would you still stick to -- let's say with the

1 one application method, you have a number of data sets
2 available. But maybe -- perhaps under different
3 meteorological conditions, but still in extreme range,
4 would you come up with something different than you have
5 today?

6 MR. SULLIVAN: If I had 200 years of meteorology
7 and I had, you know, 20 data, I would be in heaven. That
8 would be great. I would not do it this way. No.

9 Because I would have 200 years of data for that
10 location. I wouldn't have to expand it to account for all
11 this variability that I am trying to account for. I don't
12 think I have to. I don't think there would be a big
13 benefit to it.

14 It being the data itself. We don't have that
15 many years. So we are trying to do a better job of
16 capturing the various things that could occur over a long
17 period of record.

18 Although, if I had 200 years, I probably would
19 use it as a base. I would probably still try to account
20 for the uncertainty. Because what if you want to go even
21 further out than that. You could still put the

1 uncertainty in there. That would show you the variability
2 change.

3 Right now we're trying to account for
4 variability by going from five to 200. So I don't know.

5 DR. BARTLETT: I guess what I'm getting at is
6 that there is variation in wind and meteorology in reality
7 of some sort and then there is measurement uncertainty.

8 The same thing with emissions. There is
9 variation in emissions, actual emissions. Then there is
10 variations in our estimates or uncertainty in our
11 estimates.

12 It seems like those factors are confounded to a
13 certain extent. And the way we have traditionally dealt
14 with that is to get more samples and more studies.

15 What is unique about what you are doing here is
16 trying to do that in a different way. But I guess
17 something that makes some of us uneasy is that -- doing it
18 from one study for one technique and what the consequences
19 are like that.

20 If you had three studies using the same applied
21 technique, how would you approach this differently?

1 Would we be seeing a different probability at
2 work? Would you make use of the real variation that we
3 would be able to discern by -- of emission patterns that
4 we could see?

5 MR. SULLIVAN: For example, if I had three
6 studies with distributions similar to what I have for,
7 say, the case study here, if I had three studies
8 representative of the same region, those could be merged.
9 Those could be all used in the assessment.

10 I'll take back what I said before. If I had 200
11 years of meteorology, I don't think I would have do
12 anymore. That would probably be quite good.

13 The answer is you could put together data sets
14 to further reduce the need to expand things in a
15 conference (ph) .

16 But if I had multiple field trials I could put
17 together into one assessment, that would be a good thing
18 to do.

19 DR. BARTLETT: For the technique using ISC as
20 backtracking for emissions, from what I understand, there
21 is very few studies validating that method. Do we have

1 any idea what the level of uncertainty is of that method
2 per se without looking at standard errors of a particular
3 study? And -- I guess that's the question.

4 MR. SULLIVAN: Well, the issue is if -- if the
5 question is how accurate is the model itself, putting the
6 emission calculation aside, the method of modeling I think
7 it has been demonstrated that the ISC model is accurate.

8 I mean, EPA guidance will say within 40 or 50
9 percent typically if you don't constrain it in time and
10 space. You would arguably do better than that if you're
11 just concerned about what is the distribution over a
12 course of a long period of time. It has been
13 demonstrated.

14 There's been many tests done over the years of
15 the Basian (ph) Gaussian concept in ISC.

16 Yes, there is less testing of the area source
17 and the point source mechanism. But there is no reason to
18 expect -- that I can think of that that area source
19 treatment would have more bias or problems than the stack
20 treatments would have.

21 DR. BARTLETT: So there isn't really an estimate

1 of what the uncertainty of the method is for an area
2 source like this for the backtracking method that you are
3 aware of? Now, if you did have that or if you take the
4 uncertainty that -- you said it was 40, 50 percent
5 uncertainty?

6 MR. SULLIVAN: That's what EPA quotes in their
7 guideline. But that's more in a regulatory context.

8 DR. BARTLETT: Right. Could you incorporate?
9 If you had such uncertainty factored, could you
10 incorporate that in your variation with your standard air
11 that you are deriving from your sample?

12 MR. SULLIVAN: You could. I mean, part of that
13 is due to the inputs that we're discussing here today and
14 those uncertainties. Part of it is due to the comment Dr.
15 Spicer made earlier about the sigma Ys and sigma Zs.

16 You certainly could do some test runs of that to
17 show if we were to have some uncertainty in those values,
18 what would that do? But it is a combination, though. The
19 errors that EPA is describing is a combination of input
20 errors and algorithm limitations.

21 Kind of hard to separate those two things out.

1 The best we can do now is account for the uncertainty in
2 the inputs, I believe.

3 DR. HEERINGA: At this point I have quarter
4 after 3, if the panel has any other critical questions
5 they would like to ask of Mr. Sullivan at this point. Not
6 seeing any, I would like to call for a 15 minute break
7 reconvening here at 3:30.

8 At 3:30 we will begin the period of public
9 comment. And to start the period of public comment, I
10 believe that we will have the representative from the
11 registrant with chemical specialty to come up and maybe
12 give a short introduction, answer some of the questions
13 that were raised this morning and then maybe take a few
14 questions from the panel.

15 And then I believe there may be one additional
16 public commenter.

17 If there is anyone in the audience who is
18 interested in making a public comment, would you please
19 see the designated federal official, Paul Lewis, here
20 during the break.

21 Thank you very much. We'll see everyone back

1 here at 3:30.

2 (Thereupon, a brief recess was taken.)

3 DR. HEERINGA: Welcome back to the conclusion of
4 our afternoon session of the first day of our FIFRA SAP
5 meeting on the topic of Fumigant and Bystander Exposure
6 Model Review, focusing on today and tomorrow, the FEMS
7 model.

8 At this point in time we are going to open our
9 period of public comment. And as I indicated before the
10 break, if there is anyone in the audience who would like
11 to make a public comment, I would like to make sure that
12 you get the attention of Mr. Paul Lewis, the designated
13 federal official.

14 We do have one scheduled public commentor, and
15 that's Dr. Bill Feiler representing Amvac Corporation.

16 I suspect that I know there will be a couple of
17 questions that we have held over from this morning that
18 are important here and that Dr. Feiler hopefully will be
19 able to answer.

20 I want to make sure too that as we go through
21 this presentation discussion that to keep things in time

1 perspective that we focus on aspects of the chemistry that
2 are relevant to the development and application of this
3 particular model.

4 Dr. Feiler.

5 DR. FEILER: Thank you. A couple chemistry
6 questions, which came up this morning, which I will
7 address in a second, but I did want to make a correction,
8 if you will.

9 I did my dissertation in quantum mechanics at
10 the University of Florida. And the discontinuities we see
11 in this are totally experimental. They have nothing to do
12 with quantum mechanics. And black holes are astronomical,
13 not quantum mechanical or this sort of thing, I hope.

14 But the one question about the hydration number,
15 if you will, of metam, what actually was applied was 320
16 pounds per acre of anhydrous material.

17 And when you adjust that to the MITC equivalent,
18 you use that on anhydrous basis, and it is some place
19 around 180 pounds of MITC per acre that's being applied.

20 I prefer to use 4.26 pounds of material per
21 gallon and 2.4 pounds of MITC equivalent per gallon of

1 product. And hopefully that answers the questions that
2 were vis-a-vis that.

3 The other question had to do with enhanced
4 degradation. And I guess this is a very old phenomena.
5 It has been rediscovered more recently. It is not
6 something that we have addressed recently other than to
7 note that people are rediscovering it.

8 I went back and talked to some of the old hands,
9 those in the 50s that first started working with metam.
10 And it was a phenomena that they had observed.

11 They in general had to apply once a month in
12 order to see enhanced degradation. The folks in Australia
13 are applying fairly -- that have recently republished this
14 sort of information are also applying fairly quickly.

15 There doesn't seem to be any indication of that
16 for an annual application. But it is a possibility. But
17 by and large, because of biological regeneration and so
18 forth, I would be a little bit surprised that it really
19 had any significant impact.

20 And whatever we are doing is basically looking
21 at the flux of a real world type application. And so I

1 tend to think it is not going to be a particular problem.

2 With respect to any other chemistry questions,
3 let me first say that there probably a lot of people here
4 that know a lot more about both the efficacy and the soil
5 dynamics and that sort of thing.

6 When we start talking about the quill (ph)
7 chemical, I may be able to have a little bit more
8 expertise than some of you all, but not a lot.

9 DR. HEERINGA: Thank you, Dr. Feiler. If you
10 would entertain a few questions. Dr. Ou.

11 DR. OU: I would like a response. A couple
12 question is about hydration because the chemical standard
13 I bought from a chemical company shows us two water
14 molecule from organic chemistry book. When it
15 crystallize, also contain that two water molecule.

16 (inaudible) can make a hydrous in the compound.
17 So use 100 compound. There is no question for me to ask.

18 The other enhanced duration -- (inaudible) the
19 enhanced duration is -- I research. Enhanced duration
20 (inaudible) in 20 years. And you apply the field.

21 In some cases can be -- in an instant have a

1 (inaudible) case, which have been applied for 15 years one
2 to two times a year. And you apply (inaudible) chemical
3 (inaudible), which the chemical happened to be
4 nonvolatile.

5 When you apply the (inaudible) chemical to the
6 soil, also in the (inaudible) few minutes, 40 percent of
7 (inaudible) is gone. So sometimes it can be very serious
8 enhance duration.

9 I don't know if like methyl sodium it will
10 become very (inaudible) applied in the same field again
11 for 10 or 15 years. Because (inaudible). I apply it
12 once, enhance can occur for the metam-sodium. I'm talking
13 about MITC.

14 And I did some study -- (inaudible) last year.
15 That site had been applied. In some location it had been
16 once or twice. (inaudible) some enhanced degradation
17 occurred for the MITC.

18 I tried to follow up. Unfortunately, the site
19 had been disturbed. So I'm not able to pursue.

20 MR. FEILER: I guess I would comment that the
21 potential of that certainly exists. In most of the cases

1 where metam is presently being used, it is areas where it
2 has been used for many years. We have not been very
3 successful at introducing it from a commercial perspective
4 into new areas except marginally and very small
5 incremental type of changes.

6 So from that perspective, whatever being
7 reflected, is the "real world" type of degradation, be it
8 enhanced or normal or whatever the case might be.

9 DR. HEERINGA: Dr. Winegar.

10 DR. WINEGAR: I'm interested in understanding
11 more about the conversion rate and mechanism of
12 conversion. Because I'm thinking of what you have is a
13 situation where you apply one chemical and that's
14 converting of course to the active chemical over time. So
15 that's one time dependence phenomenon.

16 And then you have the second one, of course,
17 which is the volatilization, which is the focus,
18 obviously, of what we are interested in here. It seems to
19 me that depending on what the mechanism is that there
20 could be some dependence on soil type, which really does
21 -- there have been comments about regional differences

1 primarily based on temperature.

2 I'm wondering about regional differences based
3 on soil chemistry. And that, of course, would be
4 dependent on what is actually the mechanism of
5 degradation. What that actual change is.

6 And then along the line there it was mentioned
7 that there were some other by-products. I'm just curious
8 from a chemist's perspective what the other by-products
9 are of that reaction.

10 MR. FEILER: I guess what I would say is there
11 is really one rate, if you will, of generation from
12 metam-sodium to MITC. And there are at least two prime
13 mechanisms of disappearance, one being volatilization, the
14 other being soil degradation.

15 And that second has probably got a number of
16 subclasses that addresses some of the types of soil and
17 microbiological activity and a whole bunch of other
18 things. And the bottom line of all that is that I can
19 understand the concepts of that, but I don't think there
20 is any very good data for that that can allow the
21 construction of the wonderful soil models that Dr. Yates

1 would like to have out of this, which I would, too, but we
2 just don't have that level of information.

3 There is also, I think, a very significant
4 factor for MITC and potentially the generation or probably
5 less so of temperature. Because certainly in the Pacific
6 Northwest, the soils there they apply in the fall and they
7 have to wait until the soils warm up significantly before
8 all the MITC is gone and they don't have residual
9 phytotoxicity left.

10 In those cases there can be some fairly long
11 times. Of course from an MITC perspective, that's very
12 low and very slow generation and very slow in terms of
13 release as well.

14 So the worst case situations that we looked at
15 in California are probably and in Florida are much more
16 exposure potentials than are that type of situations.

17 But the bottom line of that is I don't think our
18 science works that good yet. We have started looking in
19 that direction.

20 Historically, people have paid more attention to
21 the efficacy aspects of metam-sodium and how to deliver it

1 to the site. In many perspectives, we are now just
2 learning despite the fact that this compound is 40 years
3 old how to deliver to the pest in a fashion where it can
4 be efficacious.

5 That's where a lot of the historical work has
6 gone. One of the advantages, if you will, of doing some
7 of this volatility work is we are able to increase the
8 efficiency.

9 And one of the nuances of the Kern County
10 studies that were done a few years ago is that the
11 agricultural community has reduced their application rates
12 slightly by the addition of these water sealing
13 techniques.

14 And one of my concerns was that if you use a
15 water sealing, you push the MITC too deep and you won't be
16 able to control the weeds or that sort of thing. That
17 turns out not to be the case.

18 They get as good or better weed control, for
19 example, on the surface, three or four inches, as they did
20 prior to using the water seal. But because of the greater
21 efficiency of use of the MITC, they are able to reduce the

1 rates.

2 And so they have been able to accomplish some of
3 the things that were mentioned at least in the theoretical
4 type discussions yesterday as a result of this type of
5 work.

6 The fundamental answer to your question is I
7 don't know how to define it that well other than to
8 recognize the principles that are involved in it.

9 DR. WINEGAR: The implication that seems to me
10 is that one of the goals as I have seen it seems to be as
11 to trying to generalize as much as possible these models
12 to be used in different locations.

13 But because of the significant data gap in the
14 behavior of the chemical in question here, if we contrast
15 it out to iodomethane where the main mechanism is just
16 volatilization whereas now we have the complication of
17 interconversion factors and then volatilization, it
18 complicates that even further.

19 And so that the implication that I see is that
20 essentially you would have to be doing all these emission
21 tests, et cetera, in just about every kind of growing

1 region that you plan to apply this to.

2 So you have the Pacific northwest, central
3 valley, the coastal area, Florida, Virginia is mentioned.

4 Am I reading too much or too little into the
5 situation?

6 MR. FEILER: I guess if you are going to take --
7 to try to capitalize on the minimum safety zones in every
8 region, that is the case. But, in fact, I don't think
9 we'll end up with that.

10 And what are -- sometime in the future we may
11 want to have to go to that as urban encroachment gets to
12 be more and more of a problem.

13 But at least at this point I believe that we
14 have addressed the worst case. And if we use that from a
15 regulatory perspective throughout the United States, we
16 will be very protective of all -- we may not be very
17 protective of the farmer and his ability to produce, but
18 we'll be very protective of the bystanders.

19 If at some place Virginia wants to have shorter
20 buffers, they have to have the product, et cetera, et
21 cetera, then we could potentially go in and do studies in

1 that area to say, okay, the emission rates under that type
2 of conditions that it is being used are half what they
3 were.

4 I also believe, though, that in the database
5 that we have got, we have got a fairly extreme flux rate
6 type of information. David talked about 80 percent in
7 some cases, 20 percent in others.

8 That's a fair -- and when you add the Monte
9 Carlo fluctuations on top of that, then you get to have a
10 very broad range in terms of emission rates. And it does
11 have an impact. No doubt it does have an impact.

12 Hopefully some place in the future we'll know
13 how to use this product even more efficiently and be able
14 to have no buffers. But at least to this point we don't
15 have that.

16 DR. WINEGAR: You are saying essentially the
17 built-in conservatism of these assumptions and looking at
18 the high end of the distribution essentially washes out
19 all these unknowns --

20 MR. FEILER: It doesn't wash them out. It makes
21 them unimportant from a risk management perspective.

1 DR. WINEGAR: I guess that's what I mean.

2 MR. FEILER: Yes.

3 DR. WINEGAR: (inaudible) somewhat moot to have
4 to be considered immediately, at least.

5 MR. FEILER: They will have to decide that, but
6 I believe that's the approach that's being taken from both
7 the registrant's perspective as well as EPA and other
8 regulatory agencies.

9 DR. HEERINGA: Dr. Seiber has a question.

10 DR. SEIBER: Maybe I'll ask it a little bit
11 differently. Let's assume a study was run and 50 or 70
12 percent of it was accounted by volatilization.

13 What do you know of the remaining 30 or 50
14 percent that didn't volatilize? For example, have you
15 done -- have there been any radio tracer experiments in
16 the soil to track it all the way down to mineralization.

17 Have there been intermediates formed? Do some
18 of it get bound and then slowly released over time as MITC
19 or something else? And I'll ask a similar question in the
20 atmosphere, whether there is any breakdown products that
21 have been identified.

1 MR. FEILER: There have been some studies of the
2 nature that you have described in the laboratory.

3 Those that I'm aware of have tended to have a
4 highly percentage of material emitted. They have not used
5 the type of sealing or the type of containment systems
6 that are being used in the real world today.

7 I don't think there is anything done in the real
8 world today. And unfortunately, from a material balance
9 perspective, we are assuming basically that in every bit
10 of this work, volatilization work, whether it be for metam
11 or methylbromide, whatever, that the flux rates that are
12 derived via this back integration method can be integrated
13 and compared with the application rate in order to come up
14 with this percent of material volatilized.

15 And there is no other side of the equation
16 balance of that. They could be very high. They could be
17 very low. The only defense for that is that they tend to
18 be fairly high for all of the fumigants.

19 And so it is probably defensive in terms of risk
20 management as compared to the real world. It could well
21 be that half of methylbromide is degraded or it could be

1 that 90 percent of it is evolved.

2 And we have no way of really confirming -- in
3 that case, I guess we could on a small scale by looking at
4 bromine or with methyl iodide looking at iodine.

5 To do that with MITC becomes realistically only
6 radio tagged. I don't want to get into that sort of big
7 scale real world type radio tag exposure of (inaudible)
8 levels since you have levels of detection that are
9 available.

10 On the air side of the thing, I guess you have
11 done some work a few years back which have shown some
12 contained system degradation.

13 And we have looked for the MIC, which you found
14 in the experiments as being one of the potential
15 by-products and found it at much lower levels than we
16 would anticipate predicated on the lab studies.

17 DPR, ARB have done some work of that also. And
18 so the suggestion is at least at this point that we are
19 not increasing the toxicity because of the potential air
20 degradation.

21 But again, in that case we have got no real --

1 in the other degradates that would define hydrolysis, that
2 sort of thing from MITC would be less toxic type
3 materials.

4 DR. SEIBER: I think Mr. Sullivan mentioned half
5 life in the air. I don't know. I think he said one day
6 or something like that, which I guess was an average.

7 MR. SULLIVAN: One to four days.

8 MR. FEILER: I am not aware of any particular
9 studies that are reproducible scientific studies that
10 would give that sort of number.

11 Certainly, any rain and that sort of thing would
12 really take it out for MITC. Just like it would for
13 methyl iodide. And then when it got into the soil, it
14 gets into other mechanisms of degradation.

15 DR. HEERINGA: Dr. Wang.

16 DR. WANG: The molecular weight of MITC is much
17 heavier than air. So in the dispersion models, this
18 probably goes a little bit beyond just chemistry, has
19 those density ever been considered in those, because
20 concentration is so low that it is no longer a factor?

21 MR. FEILER: I guess it is a gas at that point.

1 And it is mixed, so to speak. So the density of the
2 molecule doesn't in the modeling, at least, perspective,
3 doesn't come involved in what you are doing.

4 I'm not quite certain what your --

5 DR. WANG: If it is during the evenings that
6 inversions layers occur in those kind of conditions, do
7 you think that may exacerbate the situation?

8 MR. SULLIVAN: Just to clarify.

9 In terms of the density factor, density in this
10 kind of modeling generally is not a significant factor.

11 If you had a chlorine tank, for example, that
12 released gas phased chlorine, that that would be a very
13 important factor. That's a huge mass we are talking
14 about.

15 The levels released here, the density would not
16 be a substantial factor.

17 MR. FEILER: It would be nice if we could
18 separate it based on the density, but it doesn't work that
19 way. It is dilute enough that it's in a solution basis, I
20 can't remember the name of the chemist that talked about
21 polluted solutions. This is polluted air. Very dilute

1 and different types of dynamics, if you will.

2 DR. HEERINGA: Thank you very much, Dr. Feiler.

3 DR. HEERINGA: At this point in time I would
4 like to make one last call. Is there anybody interested
5 in the opportunity for a public comment?

6 Not seeing any further interest, I would like to
7 move on to the next item on our agenda for this afternoon.

8 And that is to begin a formal review by the panel of the
9 questions that are directed to it by the EPA.

10 Before we do that, I'll turn to Mr. Dawson to
11 see if there is any elements of clarification on any of
12 this before we begin.

13 MR. DAWSON: No, I think we are fine. Thank
14 you.

15 DR. HEERINGA: Just for the panelists, the
16 questions themselves have been outlined here on the screen
17 and broken into kind of the subelements of the individual
18 question. Many of these are multicomponent questions.

19 So I think that effort has been made to sort of
20 break out the individual subelements to make sure that we
21 address each of them in our response.

1 At this point, Mr. Dawson, if you would like to
2 read the first charge question to the committee.

3 MR. DAWSON: Thank you. The first question
4 really focuses on documentation. The background
5 information presented to the SAP panel by the FEMS
6 developers provides both user guidance and a technical
7 overview of the system.

8 We have four basic subquestions within this
9 question.

10 A, is this document sufficiently detailed and
11 understandable.

12 B, are the descriptions of the specific model
13 components scientifically sound.

14 C, do the algorithms in the annotated code
15 perform the functions as defined in this document.

16 And D, were the panel members able to load the
17 software and evaluate the system including the presented
18 case study.

19 DR. HEERINGA: Our lead discussant in response
20 to this question or series of questions is Dr. Hanna.

21 DR. HANNA: My response is for the first part A,

1 is this document sufficiently detailed and understandable
2 I would say yes. I think everything in a clear way and
3 have good flow from one part to the other. And also, the
4 glossary explains the acronyms, and all the kind of
5 references used through the text was easy to read.

6 The only thing that I would suggest is that if
7 now after this discussion and also during my reading, if
8 we can a little bit clarify the issue related to the
9 experimental, the 200 years and the five -- or the five
10 years, how we construct the experiment in a way that the
11 reader will be able to follow exactly what was described
12 here based on the questions that we were asked.

13 Are the descriptions of the specific model
14 components scientifically sound? I would say yes to the
15 limit to the knowledge that we are in -- related to ISCST
16 3 model and it has kind of been evaluated model and also
17 to the limit that now we know that as Mr. Sullivan has
18 shown that the next direction is going to the AERMOD.

19 And I'm glad really that he showed this
20 stability kind of criteria that probably will make a big
21 difference. Especially with this kind of scales for the

1 dispersion modeling that we have been seeing for this kind
2 of application. 100 meters, 1,000 meters.

3 And this going to make big difference, I hope,
4 in the AERMOD. Still the AERMOD has to be still verified
5 and evaluated. I think there are effort in this
6 direction.

7 Again, back to the document itself, it would be
8 good to add a section about the limitations and the
9 pitfalls, Mr. Sullivan, and also it is actually is very
10 good that we have this section, because that really tell
11 us how far we can go with this kind of application, what
12 we are missing, what we can do better and what we can
13 watch in the future for any development or improvement.

14 The figures also in the document, I think
15 explain a lot and maybe also even based on the discussion
16 here if can add certain comment like the questions that
17 were asked about, Dr. Yates, about the single point at the
18 certain -- that also a good point, at the certain
19 distribution or why is that critical and how this single
20 point is not as a maximum there that the whole thing can
21 be changed.

1 But explanation in this regard I think will add
2 to the document.

3 Do the algorithms perform the same function? I
4 assume they do. Again, not being knowledgeable of ISCST-3
5 model, I would say that that will -- that they do the
6 same.

7 I did not run the model. I did not have time to
8 download the model which is part D by myself to run it,
9 but I have run similar cases that I saw what the approach
10 of the documentation related to running the model. I
11 think it will run. But to be honest, I did not run it
12 myself to this limit.

13 So that's basically my general comment. Probably
14 if I had more time I would go further, but again, even
15 with that time that I have, I find the document, the
16 bottom line is written in a well and clear way.

17 DR. HEERINGA: Thank you, Dr. Hanna.

18 The associate discussant on question Number 1 is
19 Ken Portier.

20 DR. PORTIER: On the documentation, I agree
21 with Dr. Hanna. The FEMS documentation seems complete and

1 well organized, although I might say a little bit wordy.
2 It is a long document.

3 The author follows EPA documentation guidance,
4 makes linkages to existing literature and includes full
5 references, which I really appreciate.

6 You could track the arguments and I think that's
7 really (inaudible). On the description of the specific
8 model components, again, by scientifically sound I
9 understand that the documentation would allow a
10 knowledgeable user to recreate everything discussed in the
11 document.

12 And I think by this definition, the descriptions
13 of the model components is sound.

14 Did the algorithms perform the function as
15 defined in the document? FEMS uses a series of Fortran
16 executable programs, batch files, and base modeling files
17 interacting with the user through an input dialogue within
18 a DOS prompt.

19 The Fortran code was easy to read and seemed to
20 perform as expected. There are some problems with the
21 documentation in the Fortran code. A number of the files

1 had very little documentation with no description of their
2 function in the code file.

3 Descriptions were provided in the supporting
4 technical documentation. It is only the work of couple
5 hours to add the appropriate comments to the code.

6 Most of the logic of the system is incorporated
7 in the batch or what we call bat files. These are also
8 sparsely documented in the code set with slightly more
9 documentation in the technical report.

10 The use of a .BAS file extension for the base
11 modeling files was initially confusing because my system
12 identified these as visual basic code sets and wanted to
13 open up visual basic.

14 One quickly comes to understand the nature and
15 function of these files, although, again, there is very
16 little documentation inside the files.

17 In conclusion, between the technical
18 documentation and the program files, one can quickly get
19 an understanding of what the program's doing.

20 Unloading the software, the FEMS system comes
21 with precompiled Fortran modules. The batch and base

1 files should have needed no modifications to run the test
2 case.

3 While I did not run the program because of time
4 constraints, there is some major concern on my part that
5 the program will run as presented to us on the CD rom.

6 For example, the random dot batch script that's
7 the major program component on the CD rom was actually
8 labeled Random.bas.

9 So if you try to run the welcome dot, the
10 regular script, would have gone along and then hit call
11 Random.bat and it wouldn't have found it. It would have
12 looked, I think - - I don't think it would have looked for
13 Random.bas. So you have some file type switches.

14 Another example is -- so if had tried to run the
15 program, I think it would have stopped at that point.

16 There were some other programs that were
17 mentioned in the documentation that I could not find in
18 the program files.

19 In particular, the Ind.bat file I couldn't find.

20 But this could be Indoor 2.bat, which is not documented.

21 So kind of in general I found it difficult to track the

1 documentation to the programs provided.

2 The general feeling, though, that I really don't
3 think it would have quite run from the CD rom that we got.

4 This raises a more general concern probably for EPA and
5 Cal DPS about the current structure of the film system
6 composed as it is of these many interlocking parts.

7 I think this would be very difficult to manage
8 if there were a fairly large user base. Now I know we are
9 not talking about a large user base. We are probably
10 talking about a few knowledgeable technical people who
11 would run it.

12 But still, any time you decompose something like
13 this, it is great for prototyping, it is great for testing
14 components. You know if something doesn't work, you only
15 have to run a small part to check what is going on. So I
16 understand why it is structured that way.

17 But if we are ever going to give this to
18 somebody to run, I think you are going to have to kind of
19 consolidate some of this and simplify the structure.

20 For example, everything in the nine bat files
21 probably could be put in one file. And this with careful

1 planning would work, but it would reduce some of the
2 current flexibility in the program.

3 As it now stands, the user progresses
4 sequentially through the process with the ability to look
5 at intermediate results along the way. Steps that produce
6 output that doesn't look correct can be rerun without
7 having to start all the way from the beginning, which is a
8 real time saver. Right?

9 This is an advantage in a process that can take
10 up to eight hours to complete. One of the other things I
11 thought about as we were going along, and I haven't made
12 my notes yet, is that this is as it is currently
13 constructed, this is a great program for parallel
14 processing.

15 You were talking about renting 20 computers.
16 Well, in places like the University of Florida, in the
17 evenings, we can easily connect 2,000 computers. So
18 running 100,000 iterations would be one night's work in a
19 place like that where you could quickly just separate this
20 out.

21 Because it is so modulized. Each of these runs,

1 could you assign it to a different computer and then
2 collect the results and tabulate.

3 I think this does have the benefit to actually
4 be able to run very large iterations with some minor
5 changes to its structure.

6 DR. HEERINGA: Thank you, Dr. Portier. Dr.
7 Winegar.

8 DR. WINEGAR: I generally concur with the
9 comments made in regards to the completeness of the
10 document. Thought it was pretty well organized and pretty
11 complete.

12 Except for one thing that I found was difficult
13 to get out was anymore detail about the TOXST model. It
14 was referred to every other sentence nearly, it seemed,
15 but I couldn't find any real description of what it was
16 all about.

17 I did a Google search and it came up with some
18 Spanish document. I couldn't find anything on the EPA web
19 site.

20 Now, granted, I only tried a couple times and
21 there is probably an easier way to do that, obviously. But

1 I felt at a loss about understanding what that was all
2 about.

3 MR. SULLIVAN: EPA did that have that on the web
4 site. Because they haven't made it current to the ISC 3
5 callouts, it is not on the web site now.

6 There is an EPA document available, the users
7 guide to the TOXST model that is available. But certainly
8 the language in there about TOXST could be beefed up in
9 the background document to make it more complete.

10 DR. WINEGAR: I would recommend that.

11 DR. HEERINGA: Dr. Seiber.

12 DR. SEIBER: I would like to -- I didn't mean to
13 cut in if you were not finished, and commend the authors
14 for providing reprints of two peer reviewed manuscripts.

15 To me, that was very helpful. I'm a little more
16 comfortable reading things in manuscript form, go from the
17 experimental to the results to the discussion. So I
18 appreciated that.

19 The only thing I did notice that was a little
20 annoying for me personally, but it is probably my own
21 fault, is the back calculation method is the details are

1 back in an appendix. Unfortunately, I forgot to bring the
2 appendix with me. Again, that's just a small detail.

3 I think the back calculation, though, is a key
4 thing. And we'll have some comments maybe on that when we
5 get to the appropriate parts later.

6 I think one other -- and this is a general
7 comment. It is not a criticism or anything. But if you
8 really wanted us to go in and plug numbers in and see how
9 the model worked and give it a good test ride, that would
10 be beyond the scope of certainly what I would have
11 expertise for or time for.

12 And I wondered have you done some debugging or
13 validating yourself, Mr. Sullivan, say with some
14 colleagues or others, maybe agency folks who have tried it
15 out just to see how it performs?

16 MR. SULLIVAN: We had several individuals try
17 it. And as far as we know, the disk that we had did run
18 on their computers. So I would hope that if you did run
19 it that it would go through okay on yours.

20 But yes, it was tested it out. It did run on
21 their machines. I can say that before we did that process

1 my first reaction was we don't understand how to run it.

2 That process was very helpful to us in
3 clarifying the inputs and making it so people could do
4 that.

5 At this point what should happen if you load it
6 on to your computer, go into to that subdirectory and just
7 type in program, the prompt should come up and you should
8 be able to run the test case.

9 It probably will not do the indoor set or the
10 personal exposure set, and that really is not part of the
11 review here.

12 DR. HEERINGA: Dr. Yates and then Dr. Baker.

13 DR. YATES: I don't know the problem that Dr.
14 Portier has mentioned, you know, with the file name. I
15 don't know where that is requested by the program, at what
16 point in execution.

17 But I did load it up. I ran it. And it ran for
18 a while. In the DOS box there was all sorts of messages
19 and I remember reading that it was going to take eight
20 hours. I thought, I don't have eight hours.

21 So I ended up stopping it, but it did work up

1 until the point I hit control C to tell it to stop
2 executing. So I don't know.

3 DR. PORTIER: This would be further. The places
4 ran .BAT is like the fourth item in the program script.
5 Right? The program script does the welcome, which you
6 would have seen in your DOS box. Then it would have done
7 the program that asks for all the information.

8 It would have gone off and ran a Fortran code
9 to process something. Then it would have called Ran.bat.
10 That's when it would have died. So it would have
11 probably been quite a ways into the program before it
12 would have come up and said can't find this program.

13 DR. YATES: I probably ran it for like five
14 minutes before I said -- I was running out of time.

15 MR. SULLIVAN: We gave it to probably four or
16 five people to test before they made all those disks. It
17 ran on those computers. We can check it after. And
18 actually the programmer is here.

19 I'm not the programmer. Mark Holdsworth from my
20 firm is here in the audience. He developed the code, most
21 of the code. Dennis Hlinka, another meteorologist, helped

1 him with that process.

2 We can bring him up if you want to ask specific
3 questions, but it should have ran. It ran when we tried
4 it. We gave it to other people that were involved to try
5 it on their machines.

6 DR. YATES: With respect to the documentation, I
7 kind of feel the same way that Dr. Seiber does with -- I
8 read the manual first. And I had a lot of questions.
9 Sometimes I wasn't sure -- sometimes it was information in
10 a section that confused me more than helped me understand
11 what was going on.

12 And then afterward, I read the papers. And then
13 all of a sudden it was like, oh, okay, now I'm starting to
14 go see what is going on. I would suggest when you edit
15 this that it might be better to kind of keep the -- you
16 know, the structure is okay.

17 But keep each section kind of -- the comments
18 directed just to what you are talking about. Don't bring
19 in any side issues. It is a little wordy. I remember
20 that as well.

21 But I know you have all the information and

1 probably more than -- in some ways more than what a person
2 needs to understand the model. Sometimes you are
3 explaining how the model could be used for something.

4 And at least for -- at least in part of it it
5 just needs to describe the -- kind of like you did in the
6 paper where you have methods, you have the theory,
7 applications, you talk about the results when you show an
8 example.

9 And not too much extraneous material. Then
10 maybe you can have discussion section later where you
11 include all that. It would have helped me because I
12 wouldn't have necessarily needed to read the papers,
13 although, I did find it interesting. It was worth the
14 read.

15 But anyway, I think there needs to be some work
16 done on -- kind of like put it through a peer review. If
17 you do, I think it will come out being a very good
18 document.

19 MR. SULLIVAN: Streamline it down, basically.

20 DR. HEERINGA: Dr. Baker and then Dr. Wang.

21 DR. BAKER: I was able to load it and run the

1 software. So at least in my case it did work.

2 I wanted to comment on the computational
3 efficiency or maybe ask a question. To contrast it with
4 the previous modeling system that we looked at, which
5 called ISCST 3 as a subroutine when it was needed, it
6 seems the program spent a lot of time in ISCST 3, running
7 that for the full year when now I believe not all that
8 information was necessary and that TOXST post processing
9 would just for each year just takes one specific four day
10 window of time.

11 MR. SULLIVAN: No. To develop the base files to
12 fully account for variability and uncertainty, it is first
13 running in 200 years. It is passing all concentrations
14 that exceed the cutoff threshold. I think it was one
15 microgram per cubic meter.

16 It doesn't pass every single record every hour,
17 but TOXST is designed to have ISC pass certain numbers
18 through it.

19 We set up ISC that way. But there may be ways
20 to optimize it. That would be a good idea. But those
21 runs would need to get made to fully account for the

1 variability uncertainty in the met terms.

2 DR. BAKER: There was a running concentration
3 number of the screen. I wasn't sure. That must be the
4 concentration being passed through?

5 MR. SULLIVAN: That's just on the actual files
6 for running it. It's showing you the max concentration,
7 I believe.

8 DR. BAKER: Max one hour.

9 MR. SULLIVAN: Max one hour. But you see it go
10 through day 1, 2, 3, and so forth. It has to do with how
11 many years you are simulating, will go through that
12 system.

13 It is not fast. It is one of those things that
14 if you test it, the best is to push the button at the end
15 of the day. But it could be made somewhat faster. But
16 without running all those years, it would be hard, would
17 be hard pressed to make it real fast.

18 DR. BAKER: But I did want to point out you can
19 choose one or zero for whether or not you want to vary --
20 I forget -- certainly, wind direction was one. And that
21 came up earlier.

1 You can run it with no variation in the wind
2 direction. And then run it again with variation in the
3 wind direction if you wanted to check the issue that Dr.
4 Bartlett mentioned earlier. You can vary each one
5 individually too, and that's a nice feature.

6 MR. SULLIVAN: Correct.

7 DR. HEERINGA: Thank you, Dr. Baker. We'll make
8 sure we get those comments in the report.

9 Dr. Wang.

10 DR. WANG: My comments has to do with the
11 documentation and actual function and performance of the
12 code you have currently available to us. Again, I was
13 able to load it up and run it. It worked fine for me.
14 But I also ran into a lot of functions data you laid it
15 out, but it's not working.

16 You did indicate that. Seems you are setting up
17 a code that has more capabilities than it is currently
18 able to do.

19 MR. SULLIVAN: Yes.

20 DR. WANG: The other thing to comment on the
21 clarity to use the model is that I had to go back to the

1 back of the CD that shows the steps under different
2 things. Although those pops up on the screen, I wonder if
3 a flow chart of some sort that illustrates the structure
4 of the program and different files and then a second flow
5 chart type of instruction sheet or something that shows
6 the IOs and all the different steps would be probably
7 very helpful.

8 DR. HEERINGA: Are there any other comments from
9 members of the panel for question Number 1? Dr. Baker.

10 DR. BAKER: I forgot to check when it finally
11 finished. I know it said something about the ambient file
12 was printed out, but the message like ISC3 gives that the
13 run was completed successfully would be reassuring
14 initially to get something like that.

15 MR. SULLIVAN: I think what it says at the end
16 the program is complete, but it doesn't tell you when ISC
17 finishes that that's the case.

18 DR. HEERINGA: Dr. Winegar.

19 DR. WINEGAR: One last small comment in regards
20 to documentation about the field studies that are used as
21 the basis for calibrating the emission measurements.

1 I see in there, in the main document refers to
2 attachment 1, which is the two atmospheric environment
3 papers, which I think are both good papers and all, but
4 the focus of -- a lot of that is just description about
5 the overall process in the FEMS model, et cetera.

6 And there is relatively little description of
7 the actual field experiments in those two papers, as I
8 recall. So perhaps just a short table or some kind of a
9 summary. You did describe to a certain degree I think
10 elsewhere and in your presentation what those studies were
11 all about, but it might be useful to have something so
12 that, since that's forming essentially the foundation, it
13 is important to understand what was done there.

14 DR. HEERINGA: Dr. Portier.

15 DR. PORTIER: I was just going to say clearly
16 their practice trumps my theory. So I must have read
17 something wrong in the code. If four of the panel were
18 able to run it, there is something wrong in my
19 understanding.

20 MR. SULLIVAN: No, I don't think there is
21 anything wrong in your understanding. I think you were

1 seeing files that were not being used for this test case.

2 This modeling system does have some linkages
3 built in for the future and that's probably what you saw.

4 DR. HEERINGA: Dr. Baker.

5 DR. BAKER: The run log does show all the years,
6 all the 200 years were successful. So I guess I should
7 have checked the run log.

8 DR. HEERINGA: Dr. Wang.

9 DR. WANG: A follow up comment on what I said
10 earlier is that the model currently laid out a framework
11 to do a lot more than what is capable of at the present
12 time.

13 So I think if this going to be the time to
14 evaluate, we should only evaluate what it can do rather
15 than what you are saying it will do. But it's -- can't do
16 anything like that yet.

17 DR. HEERINGA: Any other comments on question
18 Number 1?

19 Mr. Dawson, Mr. Metzger, are you satisfied at
20 this point with what have you heard? I think it has been
21 a fairly thorough response. And I comment the panel and

1 the number individuals who were able to actually examine
2 these materials and attempt the runs on the program.

3 Mr. Sullivan, any questions that come to mind
4 after this?

5 MR. SULLIVAN: Just a comment that the comments
6 regarding the clarity of the report and so forth are
7 appreciated and all those comments sound very
8 constructive, should be made.

9 DR. HEERINGA: Mr. Dawson, if we could proceed
10 to question 2.

11 MR. DAWSON: Question 2, which is focused on
12 system design and input.

13 In section 2.1, overview of conceptual model of
14 the background document, a series of flow charts, figures
15 2, 3 and 4) are presented that detail the individual
16 processes and components that are included in FEMS.

17 The key processes include emissions processing,
18 200 year weather inputs and how they are used for longer
19 term Monte Carlo sampling and TOXST analysis.

20 Question A, what can the panel say about these
21 proposed processes, the nature of the components included

1 in FEMS and the data needed to generate an analysis using
2 FEMS?

3 And question B, are there any other potential
4 critical sources of data or methodologies that should be
5 considered?

6 DR. HEERINGA: Our lead discussant of this is
7 Dr. Majewski.

8 DR. MAJEWSKI: Thank you. With respect to the
9 key processes, the first one being the emission
10 processing, the FEMS system was developed for a single
11 worst case scenario only, and as a starting point.

12 But the field testing included several different
13 application and sealing methods.

14 The Monte Carlo variables are the application
15 start time, the emission rates and meteorological
16 parameters. The non detects were changed to .1, which is
17 the path of the analytical limit of detection. And this
18 was done for transformational purposes.

19 Were any duplicate samples taken during the
20 field test?

21 MR. SULLIVAN: Yes. Each of the GLP studies had

1 duplicate samples taken every period. And those could be
2 documented here. The precision was quite good.

3 DR. MAJEWSKI: The regression fitting is forced
4 through zero. And also the use of -- there is use of log
5 transformations. The arguments presented are sound, but
6 I'm sure there is going to be more discussion on this
7 point from other panel members.

8 The system was capable of using irregularly
9 shaped field and application time lengths, and these I
10 guess are custom runs.

11 It is also capable of modeling multiple field
12 and sequential application scenarios as well as seasonal
13 runs using the appropriate meteorological data.

14 It can also be used for regional considerations
15 for different ranges of conditions to estimate the upper
16 end information.

17 These are all positive aspects of this system.
18 On the downside, there is some discussion of expanding the
19 four hour sampling periods to six hours to decrease the
20 chance of the wind speed coming from only one direction
21 and which would limit the amount of hits in the downward

1 samplers.

2 If we expand the sampling period to six hours, I
3 think this would provide less information about emission
4 trends. And this implies that the influence of possible
5 anomalous points as pointed out by Dr. Yates this morning
6 would be more important.

7 And also there was no comparison between direct
8 flux measurements versus the indirect.

9 As far as the 200 year weather inputs and how
10 they are used for long term Monte Carlo sampling, I think
11 I'm beginning to understand that.

12 The emissions are matched to meteorology
13 regardless of starting time. And here is where I have
14 some questions. I got a note here that says how realistic
15 is a 3 a.m. application time.

16 I know we discussed that. But I'm not sure I
17 quite understand that. 3 a.m., is that the start time or
18 is that the time -- is the start time adjusted to 7 a.m.
19 or --

20 MR. SULLIVAN: The field trials that are the
21 basis for these studies we are referring to here are all

1 starting approximately at sunrise, a little bit before, a
2 little bit -- mostly after sunrise by about an hour or so.

3 They are representing that type of application
4 that occurs in the daytime. So if the start of the
5 modeling sequence began at 3 in the morning, it would
6 match up to that particular emissions data suitable for
7 that time period, whatever day after the application that
8 was.

9 But it is still going to end up going through a
10 start that happened at 7 a.m. on some other day, perhaps.

11 It always starts at the same time. The actual
12 start for the application is around 7 in the morning,
13 typically.

14 It will diurnally match things up and get back
15 to that point. If it started in day 3, it is using
16 emissions data from period -- from day 3. If it's 3 in
17 the morning, it is suitable for the 3 in the morning. It
18 is making that entire sequence.

19 DR. MAJEWSKI: There seems to be no restriction
20 on stability class change with time. And the EPA ISCST
21 restricts to -- is restricted to one class change per

1 hour. And this, the FEMS system seems to better match the
2 on-site stability changes that are possible.

3 The TOXST analysis is used as a post processor.

4 It starts the application and is used for concentration
5 estimates. And it is considering the mass available from
6 the treated field downwind concentrations at particular
7 times after the start.

8 It gives frequency, magnitude and exposure and
9 estimates the acute exposure. And the model seems to be
10 well documented and reviewed. So I think it is
11 appropriate to use here.

12 The nature of the components that are included
13 in FEMS include the ability to model single or multiple
14 field sources as well as different grower objectives or
15 application objectives such as the application and sealing
16 methods, application rates, regional and seasonal
17 differences, as well as sequential applications and
18 multiple and adjacent applications.

19 Again, it was done for one scenario at one
20 location simulating the worst case as a starting point.
21 And then what are the data needed to generate an analysis

1 using FEMS, obviously, the meteorological data sources,
2 and we have had discussions on those.

3 You seem to be using the National Weather
4 Service sources, which are good. They seem to have a very
5 complete data set. And the data's quality control is
6 good.

7 And then also the field emission datas and
8 behavior of those emissions for the different application
9 types -- times and regions are needed.

10 Are there any other potential critical sources
11 of data or methodologies that should be considered? I
12 guess the only thing I would say is the density of
13 meteorological data available in the region is five year
14 data from one station suitable for one area or how many
15 data stations are optimal for a given size region.

16 MR. SULLIVAN: I believe that probably the best
17 way to handle that would be to have multiple five year
18 data sets for one particular region that would comprise
19 the base period to span it up to 200 years.

20 For example, if it was five, if it was 10 sites,
21 it would be 25 to 50 years of base data files, it would be

1 expanded to 200 through the uncertainty sampling.

2 That would be probably preferable. That would
3 capture the range, the variability in that region better
4 than just having one example.

5 I guess one is an example test case
6 demonstrating how it works. And yes, it either could be
7 an option in here for example to -- do you want to vary a
8 stability class more than one hour at a time.

9 What we have here really is suitable for let's
10 say Kern County, the experience we had there, but that
11 could be an option, to give the user more control of that
12 for other areas.

13 DR. MAJEWSKI: The other data source is
14 obviously field data.

15 I know these experiments are very expensive and
16 time consuming, but the more data you have the more
17 confidence you can have in your output.

18 But I think you did a good job.

19 DR. HEERINGA: Thank you, Dr. Majewski.

20 Our next discussant is Dr. Yates.

21 DR. YATES: I don't have all that much to add.

1 I'll kind of just try to keep it to some things that
2 haven't been said.

3 First of all, I guess in terms of the processes
4 using ISCST and TOXST, since they are the recommended
5 models by EPA and have been evaluated, I don't see --
6 there isn't really a whole lot to say in terms of whether
7 the proposed processes are a problem.

8 I mean, that's pretty much done. I think it is
9 really the data that's being used in the models is really
10 where a look needs to be taken.

11 One thing I did notice is that the -- and I
12 don't know if this has to do with the fact that you have
13 data farther away from the field than the model we looked
14 at previously, because I think you had sampling locations
15 out about a kilometer. Didn't you? Somewhere around 600
16 meters to 1,000.

17 And you had -- it seems like for the regression
18 in the indirect method for estimating the period fluxes,
19 it seemed like you had a lot more problems with linearity
20 and things of that nature.

21 I don't know if that's related, but I was -- I

1 was kind of uncomfortable when I was looking at -- when I
2 was reading it and I was seeing that at different times
3 you had to come up with different techniques to estimate
4 that period flux.

5 And by the time I was done reading that section,
6 I thought that maybe you should take a look at a
7 completely different way to get that information.

8 And just for the panel, I discussed this with
9 David earlier a little bit about a way to do that, and
10 just to try to say it quickly, one potential idea, I'm
11 sure there are many of them, but if you know the average
12 wind direction and the variance, then you could determine
13 the zone that will see chemical after emission during any
14 particular period. Right?

15 You get this plume. The receptors or the
16 sampling locations that are in that plume, you could go to
17 each one and find the flux value in ISC that will
18 perfectly match the measured concentration at each one of
19 those locations what you get is a set of flux values.

20 They are flux values now that will cause the
21 model to match the data at every one of the sampling

1 locations. What you have really is a distribution of
2 fluxes which gives you some information about variability.

3 You take the average of that set. You get the
4 average value, which would be very similar to the slope of
5 the line if you did it that way, but you don't have to
6 worry about offsets or innersets.

7 You don't have to worry about linearity. You
8 are just taking a straight mean.

9 That's a simple -- the statisticians could tell
10 me whether I'm wrong about that. I don't know. Maybe
11 there are some issues there that I don't know enough
12 statistics to know about.

13 But at least in terms I would think you would
14 not have to have three different ways to determine the
15 emission value. And that bothered me a little bit.

16 I don't know how to resolve it except to maybe
17 just go to a completely different way to obtain that
18 information.

19 MR. SULLIVAN: One thing that we did just try
20 very briefly was parametric bootstrap analysis, very
21 similar to what you just said, where we took the measure

1 or the model at each point and then determined the
2 distribution from that set.

3 And then sampled, repeatedly sampled that to
4 address the uncertainty issue.

5 And that's another way it could be done. And I
6 would defer to the statisticians how that method would
7 compare to using least grid analysis like we were all
8 talking about before.

9 DR. YATES: And then with respect to the 200
10 year sampling, I think in principle that seems fine.
11 However, it did occur to me, actually, Dr. Spicer also,
12 and I talked about this a little bit, and it seems like
13 there would be a possibility that you might not actually
14 sample all the meteorological data that you have.

15 If you take -- for example, in ISC, what you are
16 doing is you are running four days. Then you repeat for
17 four days. But say that your meteorological sequence
18 happens to be divisible by four, then -- for example,
19 let's say you have eight numbers. You go 1, 2, 3, 4, 1,
20 2, 3, 4, then you start back at 1 for the start of another
21 fumigation with a little tweak in it and then you keep

1 going through.

2 You never start on day two or three or four.

3 MR. SULLIVAN: When I spoke before, I did
4 misspeak. Because what happens, we are developing these
5 data sets, these five year data sets.

6 In order to avoid that problem, we call it
7 cutting the data set deck. We do that because TOXST does
8 not have a random seed. It didn't need it for its
9 purposes then.

10 But doing these 10,000 year simulations, that
11 would become an issue. So that is taking into account
12 every five years when we are running a 200 year data set,
13 it does make that cut.

14 So in that sense, the data will not always have
15 the same day coming up and it will be more random.

16 DR. YATES: That should be put into the
17 documentation, I think. Otherwise, people might assume
18 that there could be a bias depending on the length of the
19 data.

20 In terms of just the flow charts that they talk
21 about in this question, they all look appropriate. I

1 didn't see any problem with those.

2 One other thing, just a comment, I guess, is
3 that the way that you are doing the Monte Carlo analysis
4 is through bootstrapping.

5 I know a long time ago I did a little bit of
6 this kind of work. What we always did was try to
7 transform the input data into distributions and then you
8 sample the distributions instead of the bootstrapping.

9 Let me finish. And the reason why that might
10 -- I'm sure that would be very difficult. But a reason
11 why it might be good is that then someone could come in
12 and take a distribution and they could actually do some
13 adjustment to it to look at some kind of very extreme
14 events in a hypothetical sort of situation, and maybe look
15 at the rare events a little bit better than what you can
16 do by bootstrapping.

17 MR. SULLIVAN: I actually just did a few tests
18 with bootstrap. Our basic analysis does not use bootstrap
19 sampling techniques. It is doing the distribution based
20 upon the least squares analysis, sampling that.

21 DR. YATES: So you are actually developing like

1 probability distributions?

2 MR. SULLIVAN: We are developing the
3 distribution -- showing the percentiles for the mean. The
4 percent confidence in the mean. We are sampling from the
5 2.5 to 97.5 percent confidence.

6 Bootstrap sampling would be an alternative way
7 to account for the uncertainty in emissions. It has
8 potential to solve some of these problems. It is more
9 difficult.

10 DR. HEERINGA: Our next discussant is Dr.
11 Seiber.

12 DR. SEIBER: I have a few comments. Again,
13 going back primarily to the emissions processing that is
14 used and discussed, some of my comments could probably go
15 under question 3, but I'll go ahead and give them now.
16 The model uses back calculated flux and basically relies
17 on that methodology. And I think -- I have nothing
18 against that method. I just see that there is kind of an
19 inherent assumption here that it has been used for some
20 time with some success and we are used to it.

21 It is being used for different chemicals, but

1 still I don't think we should go too far out on that limb
2 without having some ground truthing or validation or
3 verification by some other method.

4 And it could be an experimental method
5 preferably. It could also be just comparison with other
6 models and see if they are giving the same -- models that
7 simulate the flux or emission that are designed.

8 I think Scott Yates gave a couple examples of
9 that previously and maybe there is others. But it just
10 seems to me there ought to be some independent check on
11 that.

12 It really does two things. First of all, it
13 gives you a comparison. It makes you feel more confident
14 in what you are doing. But secondly, if there is
15 something unusual going on, it might help to pick that up.

16 For example, I don't think it is sufficient to
17 dismiss degradation processes either in the atmosphere or
18 deposition processes.

19 I tend to agree that's our gut feeling, that
20 they are probably not important. Certainly, right around
21 the field.

1 They may become more important as you get down
2 to a kilometer or possibly farther when you are in the
3 Bakersfield heat with high ozone levels and sunlight and
4 who knows what else.

5 I mean, that one day half life might become 15
6 or 20 minutes. We have seen it with other chemicals. It
7 really plays tricks on you.

8 I don't think we should just take the idea that
9 metam decomposes to MITC. It volatilizes and it drifts
10 downwind, period. I think it is a little more than that.

11 So the other point. Just I appreciate the fact
12 that you have given consideration to FEMS being applied to
13 the situation where multiple fields are applied
14 simultaneously or sequentially. I think that's a real
15 benefit.

16 And as metam is used, MITC is used for
17 fumigation, people are going to logically ask the question
18 what are the ambient levels at some point.

19 And they are probably going to want to pick up
20 FEMS or one of the other models and start doing some
21 calculations. It might be good to know what those

1 stability terms are in the atmosphere for these
2 chemicals. So that is the comment.

3 DR. HEERINGA: Thank you, Dr. Seiber.

4 Are there any other comments from members of the
5 panel. Dr. Baker?

6 DR. BAKER: Following on that comment, in a
7 significant way, I would be concerned about the
8 environmental fate of any chemical that we are applying.

9 But I think for this application we are
10 concerned about the plume where the concentration is above
11 a threshold. When the concentration drops below that
12 threshold, then it moves in to another arena, which is the
13 environmental fate arena.

14 This was brought up in the other panel too. I
15 think the time scales are just so much different. Even the
16 half lives are reported for nominal either national or
17 global average hydroxide concentrations.

18 But even accounting for high ozone days, it can
19 be shortened. But I still think you have significant
20 mismatches in the time scales on which these things occur.

21 The time scale of the plume -- movement from the

1 source within a plume to the region bounded by the
2 threshold concentration defined from a health endpoint is
3 very short.

4 And environmental fate matters are a much longer
5 time scale, so we would be looking at concentrations in
6 the environment at much lower levels.

7 DR. HEERINGA: I just want to direct the panel's
8 attention to the second part of this question, part B,
9 just to make sure that any thoughts that we might have on
10 other critical sources of data or methodologies.

11 I think Dr. Yates and Dr. Majewski have already
12 mentioned some things. If there are any other ideas on
13 this?

14 Some of the ideas related to the emissions
15 modeling, and your idea particularly the use of, sort of,
16 the calibrated means we might actually treat that tomorrow
17 morning again in conjunction with question 3.

18 I'm sure that will come up. We'll be sure not
19 to forget that.

20 Dr. Majewski.

21 DR. MAJEWSKI: Would it be useful to use the DPR

1 methylbromide data and run it through? I mean they have a
2 wealth of information. It might be nice to see your
3 results compared to theirs.

4 MR. SULLIVAN: That would probably be a useful
5 analysis to do, because there are -- I think it is 34 or
6 35 studies available there. That would be helpful.

7 DR. HEERINGA: Good suggestion. Dr. Bartlett.

8 DR. BARTLETT: One question, I guess, is when
9 you use the -- you had the station, the monitoring
10 stations fairly far out, so I assume they were outside the
11 area of the projected buffer zone. Right? The predicted
12 buffer zone. Is that true?

13 MR. SULLIVAN: Hopefully that is the case. We
14 had multiple distances in there, because, of course,
15 dispersion with stability. But the stability terms in the
16 model, the plume is going to grow with the function of
17 time.

18 We wanted to have the monitors at different
19 levels along the way to do the fit. The goal there was,
20 yes, there may be more scatter, but the issue is if there
21 are near field effects such as during the afternoon

1 convective period, that may give a more accurate overall
2 description.

3 DR. BARTLETT: It seems like having those
4 stations in some sense helps the back calculations the
5 farther out stations because you have more data points.

6 But I think it would be an interesting
7 experiment to back calculate closer in without the far out
8 ones and then see what the predicted value is and what you
9 would predict and as far as concentration at the farther
10 out stations.

11 One of the problems that we have, I think, with
12 the use of ISC and back calculation is validation with its
13 prediction ability and going by that without having the
14 outer stations with some other things we looked at so.

15 And I just would like to reinforce with what
16 Dr. Seiber and other people have said. It would be nice
17 to see another -- we would all -- I think a lot of us
18 would be more comfortable with another study like this,
19 the traditional, reproducible study.

20 Like did something go extraordinarily well in
21 this particular study or bad or something like that that

1 have another study with this chemical or what was
2 suggested before, looking at methylbromide.

3 But there is probably other studies done with
4 this chemical as well. Something to give it some context
5 for us to know that this is a reasonable projection of
6 this -- emission is reasonable and the concentrations
7 predicted are reasonable.

8 And that this is also to get a better
9 understanding that this is an extreme case as far as its
10 location.

11 MR. SULLIVAN: What is interesting is the
12 concept that Dr. Yates discussed may allow us to evaluate
13 some of the other studies more definitively, the ones that
14 have fewer points and so forth. That would be interesting
15 thing to check.

16 Also, the point you raised. What if you left
17 off the furthest distances, that would be interesting to
18 see if it did change the numbers.

19 But also, what if you left off the close in
20 ring? What would that do? That might give a sense how to
21 design future ones. Perhaps better? Differently?

1 But I like the concept of having multiple layers
2 in a sense that if you do have any -- again, like the near
3 field issues, the later -- the further away points would
4 help to make the estimates more accurate. They may have
5 more scatter in them because of those issues, but perhaps
6 more accurate.

7 DR. BARTLETT: I think to echo that is it is
8 essential to have monitoring stations farther out than
9 what you are going to end up predicting, because
10 extrapolation doesn't work very well at all in these types
11 of models.

12 MR. SULLIVAN: Right. Near field effects issues
13 can be significant.

14 DR. HEERINGA: Dr. Portier and then Dr. Wang.

15 DR. PORTIER: I was going to comment on what Dr.
16 Bartlett said earlier. True replication here is
17 impossible. There is no way they can replicate the same
18 situations twice.

19 In an experimental mindset that would say I have
20 kind of within and between sources of variation, kind of
21 within one experiment, which is what they are dealing with

1 right now, which is the standard error variability on that
2 slope, that's the only variability term they have for
3 uncertainty calculations.

4 Repeating the whole experiment doesn't work
5 because another experiment means another time, another
6 location or even the same location later in the season.

7 So the true concept of replication variance
8 doesn't work here. And I was trying to think what do we
9 gain when we do that because that between variability is
10 confounded with climate.

11 And the model adjusts for climate, but it really
12 incorporates climate. So all you would be doing is
13 redoing the study. I'm not sure how you would evaluate
14 that. That's kind of the scary part for me.

15 The trick here is you are fitting a model. The
16 model is going to melt itself to the situation. Every time
17 you run this experiment you have a different situation and
18 the model is going to fit. I have to really maybe tonight
19 about 10 o'clock I'll come up with the replication issue.

20 On Dr. Yates' issue, just quick thinking, I
21 don't think it would work. And I think it is because it

1 is a plume model and you are using the multiple locations
2 to not just look at the flux rate, but there is that
3 spread component in that model as well that's integrated
4 with time.

5 The plume is supposed to blow out over time. But
6 it also blows out over distance. And if all you are doing
7 is trying to figure out what would the flux rate that
8 would give me the best fit to this location, it is going
9 to assume everything just went right there and you are not
10 going to have the spread, the version component, I don't
11 think.

12 Quick thinking. Those of you who really know
13 the ingredients of the model might be able to correct me
14 on that. But I understand the concept of what you are
15 doing. If you could do that one at a time, you could get
16 rate estimates and then average the rate estimates.

17 DR. YATES: I think it would depend a little bit
18 on how the dispersion parameters are calculated. If they
19 use the flux -- I mean, if the flux is incorporated in
20 that, you may be right. If they are independent, then I
21 think it might work.

1 If meteorology determines the spreading, then it
2 should work, I think. But I don't know. It is just a
3 thought.

4 DR. PORTIER: It may be that that one flux
5 parameter is both kind of a mean parameter and spread a
6 parameter as multiplied through some kind of climate
7 condition, wind speed, you know, wind direction.

8 I don't know enough of the model, but I have a
9 funny feeling it wouldn't work. But you could do --
10 between what you are wanting to do and what he was talking
11 about, this idea -- or maybe you were talking about
12 jackknifing, use six of the seven points and fit the model
13 and then do that for sets of six and average those in a
14 jackknife and you would get possibly a better estimate and
15 a better uncertainty of that estimate as well.

16 That's kind of using the model in a jackknife or
17 bootstrapping. There is not enough data to bootstrap
18 here. A jackknifing.

19 DR. YATES: But just one other thought. I mean,
20 I don't know. Like you say, the people who use the model
21 really need to test it out. But it seems like the way it

1 is done now you have one -- you set like an -- a
2 concentration or a flux, I mean, just an arbitrary flux.

3 And then you get the slope and you get the
4 actual flux. You can plug that number back in. I don't
5 think it has changed the spread of the diffusion of the
6 model. Right?

7 So it seems like if that's the case, the spread
8 is set by something else. And so it is just the scaling
9 of the flux that scales the concentration at any one
10 point. So it is independent, I think.

11 That's somebody who has no -- I have never
12 really worked the with the model in any kind of you know
13 -- I'm not experienced with it enough to really know for
14 sure.

15 But it just seems like from the things I have
16 heard over the last couple days that it would almost have
17 to be that -- I would bet it works and I'm not a betting
18 man.

19 DR. HEERINGA: I don't want to interrupt. But as
20 we think about this issue, ask a question of the experts
21 here. At any point given point on that space downwind,

1 the concentration is a linear function of the original
2 flux, in which case I think the two methods actually boil
3 down.

4 In one case you are just creating a ratio for
5 each point and averaging the ratios. Well, those ratios,
6 if you force the regression through the origin, are
7 nothing but the regression coefficient.

8 In some ways you are estimating eight different
9 regression coefficients and averaging them as opposed to
10 estimating one and getting their standard error.

11 DR. YATES: But the advantage, I think -- and
12 the only reason why I was thinking about it was to get rid
13 of the intercept. Basically, what you are doing is
14 ignoring all the points outside the plume. And also, you
15 don't have to fit -- you don't have to worry about log
16 transforming.

17 DR. PORTIER: But if you assume no intercept,
18 what Dr. Heeringa is saying is if you assume no intercept,
19 the two methods would be identical.

20 If you did a regression with an intercept, you
21 are right. You are absolutely right. So your method is

1 just another way of doing the no intercept approach. We
2 can show you that mathematically.

3 DR. YATES: So basically, does that give
4 justification for what Terri was saying yesterday or the
5 question she had about what is the best way to go?

6 Does that mean that it makes more sense to drop
7 the intercept and not even consider it? Just put it
8 through the origin and that would be the same as fitting
9 the model at all the points taking the average of the
10 fluxes?

11 Because that to me is a very physically
12 reasonable thing to do.

13 DR. HEERINGA: In part that's the nature of
14 question 3. And if I could defer that until tomorrow
15 morning, I will have slept on it a little better.
16 Actually, Dr. Wang and then Dr. Baker.

17 DR. WANG: My question is similar to what Dr.
18 Portier just asked. It deals with replications.

19 Those experiments I have conducted and those
20 that I have seen usually there is no replication for that
21 particular experiment on that one time since extensiveness

1 in labor and cost.

2 But I been working with plant pathologists and
3 biologists. So I have to replicate in order for them to
4 publish their results.

5 In those scenarios, we have to reduce the sizes
6 of each plot. And so those experiments that occur, there
7 is close proximity. And the soil types and climate is, I
8 can't say identical, but I can almost call them the same
9 without too much biases.

10 I wonder if somehow you can define a minimum
11 distance to be climatically similar, then set up your
12 experimental sites, and then the plume will not interfere
13 with, say, 24 hour or four days. That way basically you
14 are creating replications and they are independent. But
15 in a manner that climatic situation is the same, that's
16 the only difference would be.

17 Then the prediction's back calculation for your
18 flux, you may compare those and give you a somewhat of an
19 independent estimate to see if that's really going to
20 work.

21 Have you thought about that?

1 MR. SULLIVAN: We have done a study similar to
2 what you said. When I referred to the USDA study done in
3 fall of 2002 in Kern County, we did two concurrent studies
4 about a half mile apart, north, south orientation.

5 They didn't interfere with each other, however,
6 we were testing a different thing.

7 We were trying to compare using the same rate
8 by chemigation intermittent sealing with another field the
9 same size doing shank injection by intermittent sealing.

10 Your point was what if you did the method that
11 way. It would require I would say at least a half mile in
12 consideration of the expected wind flow to keep things
13 separated.

14 It takes two crews. It is a wild activity, but
15 it can be done.

16 DR. HEERINGA: Dr. Baker.

17 DR. BAKER: The discussion just prior to this
18 reminded me of an idea that Dr. Spicer had talked about
19 yesterday. In the modeling world as far as the model is
20 concerned the horizontal spread is constant as it moves
21 downwind. Also, the vertical spread is constant as it

1 moves downwind.

2 We have considered challenging the model in the
3 horizontal dimension. And just some information in the
4 vertical would provide another way.

5 And I believe Dr. Spicer had talked about that
6 yesterday.

7 DR. HEERINGA: Thank you very much. I think
8 there will be plenty of opportunity, there is some
9 interrelationship among these questions, if other ideas
10 come up. And certainly I like the idea of exploring in
11 the context to question 3 some of the other fitting
12 approaches. That's excellent.

13 Any other comments this afternoon from -- this
14 evening from members of the panel?

15 Mr. Dawson, do you have anything that you would
16 like to ask about this question? Are you satisfied with
17 the responses so far? Is there anything you think we have
18 missed that you and your team would like to know?

19 MR. DAWSON: No, I think we are happy. We'll
20 also kind of sleep on it tonight and maybe come up with
21 some issues in the morning, but I think it is very good.

1 Thank you all very much.

2 DR. HEERINGA: I believe the timing is right and
3 we are right on time. We are staying with the agenda.

4 We have sort of returned to our schedule. We
5 will all plan to meet again tomorrow morning at 8:30 at
6 which time after some introductory remarks we'll turn to
7 question Number 3, which is the question relating to the
8 appropriate fitting method for the emissions.

9 I thank everyone, the audience for their
10 attendance and participation, and public commenters and
11 members of the panel. And have a good evening everyone.

12 [Whereupon, at 5 p.m., the
13 meeting recessed.]

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351

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